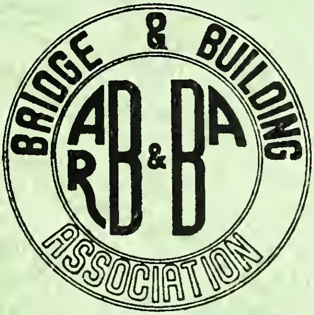
PROCEEDINGS

of the

91st Annual Conference

of the

American Railway
Bridge & Building Association



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Proceedings of the

Ninety-First Annual Conference

of the

American Railway
Bridge & Building
Association

Held at
CHICAGO, ILLINOIS
September 15-17, 1986

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TABLE OF CONTENTS

Page
Index to Advertisers 3
Officers for 1986 5
Session—September 15, 1986 9
September 16, 1986 57
September 17, 1986 105
Secretary's Report 91
Treasurer's Report 91
Audit Committee Report 92
Necrology Report 92
Report of Resolution Committee 120
Joint Installation of Officers 121
Historical 126
Constitution 131
By-Laws 134
Bibliography of Contents 174

ADDRESSES AND COMMITTEE REPORTS

Address—
Marshall Suloway, Senior Vice President, Envirodyne Engineers, Inc. 14
Pollution Control at Little Rock—
J. T. Gorley, Civil Engineer, Union Pacific 18
Track and Bridge Maintenance on the CTA—
Roy T. Smith, Superintendent Power & Way, Chicago Transit Authority 23
Early Storm Detection and Warning—
J. T. Hunter, Regional Track Engineer, Federal Railroad Administration 28
West Side Yard Construction—
S. A. LaRocca, Senior Project Manager, Long Island Rail Road 33
Committee Report—
Fall Protection and Safety Climbing Devices, R. S. Kenyon, Chairman 43
Plywood Techniques in Concrete Formwork—
W. R. Moore, American Plywood Association 49
Committee Report—
Preparation of Bridges for Protective Coatings, F. R. Gibson, Chairman 53
Industrial Application of Concrete Block Pavers—
D. C. Bender, President, Pavestone Company 55
Address—
E. B. Burwell, President, Southern Railway 57
Maintenance Practices on Short Line Railroads—
D. L. Smoot, Vice President & Chief Operating Officer, Indiana Hi-Rail 62
Energy Retrofit of Union Pacific's Omaha Shop—
R. Dunlop, Manville Commercial Construction Service 68
Committee Report—Disadvantages/Advantages of Hydraulic,
Pneumatic and Electric Tools, T. F. Waltemath, Chairman 77

Committee Report—
Roofing Systems, R. E. Phillips, Chairman 83
Replacement of Pin Connected Wrought Iron Truss Spans—
Don A. Bessey, Senior Architect, Envirodyne Engineers, Inc. 94
Flame Straightening Damaged Steel Bridges—
D. L. Holt, President, David L. Holt Company, Inc. 98
Steel Truss Repairs—
G. Krupa, Manager Structures Group, Delon, Hampton and Associates 102
Clearance Measurement Technology—
P. A. Schoville, Project Director, Union Pacific and
Dan Otteborn, President, SRS 106
Design/Build of CSX's Engine House at Rice Yard, Waycross, Georgia—
R. J. Maes, Vice President, Sverdrup Corporation 112
Bridge Replacement and Pollution Cleanup at San Antonio—
K. Wammel, Division Engineer and R. C. Karsten, Environmental/Mechanical Officer, Southern Pacific 116

INDEX OF ADVERTISERS

Page
A&K Railroad Materials 137
Bellco Midwest Corp. 139
Berkel & Company 139
Conley Frog & Switch 141
Detzel Construction 147
Dividend Information Center 143
DuPont 145
Fairmont 149
Foundation Equipment Company 147
Intrusion Prepakt, Inc. 151
Kershaw Manufacturing Company 153
Lewis Bolt & Nut Company 157
Little Giant Crane & Shovel 155
Marmon Transmotive Railway Products Division 159
Midwest Industrial Products Corp. 157
National Railroad Construction 161
Osmose 162
Power Parts Sign Company 163
Racine Railroad Products 165
Rails Company 167
SSI Industries .... Inside Front Cover
Shugart Manufacturing Company .... 168 & Inside Back Cover
Speno 169
Wadsworth Equipment Company 166
Professional Services Directory 170

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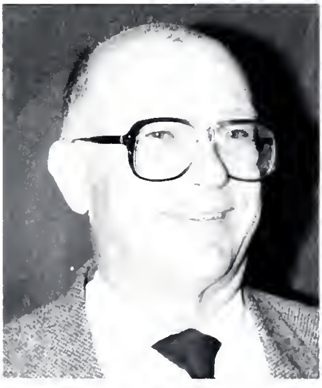

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PROCEEDINGS

OPENING JOINT SESSION

Monday, September 15, 1986

The first joint session of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America was called to order at the Palmer House, Chicago, Illinois, on Monday, September 15, 1986, at 8:30 a.m., Mr. Donald A. Bessey, President of the American Railway Bridge and Building Association presiding.

President Bessey: We will now call the meeting to order. As President of the American Railway Bridge and Building Association and on behalf of Mr. C. W. Moorman, President of the Roadmasters and Maintenance of Way Association of America, I declare this 91st Annual Conference of the American Railway Bridge and Building Association and the 98th Annual Conference of the Roadmasters and Maintenance of Way Association of America to be open and in joint session. It is proper at this time, and it always has been our custom, that we pause to ask for divine guidance and inspiration prior to commencing this conference. I would like to call on Ray Tallent, our junior vice president who will deliver the invocation.

Mr. Tallent: Will you all please stand. Dear Lord, thank you for the physical, mental and emotional stability that you have blessed us all with this morning, enabling us to do our jobs despite problems and setbacks in our personal and professional lives. Please continue to bless us with your forgiving love and understanding. Help us all to reach out and help our fellow workers, and remember that you have not given us a spirit of fear but of power and of love and of a sound mind. God wants us to achieve. Out of every setback we can find the comeback God has in mind for us. May Thy will be done in each and every one of our lives. Help us let the sun shine in our lives to help guide our fellow men. In Jesus' name we pray. Amen.

President Bessey: Thank you very much, Ray. I believe we have started a kind of warm and meaningful tradition, as last year in Dallas, Tom Rosamond, who was a former member of the Roadmasters' Executive Committee, led us in prayer before we started the conference. Now this year, Ray Tallent, our B&B vice president led us in our conversation with God this morning. I think that is a very nice tradition.

I join with President Moorman in welcoming you to the first joint session of the two associations. We sincerely hope that you enjoy your visit to the great city of Chicago. But of equal or greater importance, we urge you to attend all the sessions of this two and a half days' conference. We ask you to read the program carefully and note that it is full of excellent topics, both special features and, of course, the special subjects, generated from information furnished by you and your fellow railroaders.

My conference partner, President Moorman, and I wish to present our theme for this year's conference and that is "get involved". Attend the sessions, participate in open discussions from the floor, fill out the special subject card for next year's conference presentations, contribute information, be a leader, be a committee chairman — "get involved". "Get involved" in your railroad organizations. You will hear more on this subject this morning and throughout the conference. So let us get in the spirit of getting involved.

Now for the ladies. God bless the ladies. We have a full program of activities that has been arranged for the ladies during the conference, thanks in part to Byron Burns, B&B director in charge of ladies activities, Keith Pottorff, Roadmasters' director, and, of course, thanks to my wife, Marge, and all the other ladies helping with these activities. This afternoon there will be a wine tasting presentation in the Crystal Room on the third floor — ladies only, now. You men won't have time because you will be in one of the conference sessions. Incidentally, if, after you get back home, your wife has a nice candlelight dinner and the right wine—then you'll know that what she is going to learn about today was worth the trip!

On Tuesday morning, promptly at 9:30 a.m.

the ladies leave on a tour of the Pullman Community. This should be a very interesting tour, complete with other activities,and lunch at the Ambassador West. So there won't be much time left on Tuesday to activate the plastic credit cards!

So, check your programs, determine the sessions that are of interest to you and also, double check on where these sessions are located. Unfortunately we have to play musical floors again this year. This afternoon, the B&B will be in the Adams Ballroom on the sixth floor and the Roadmasters will be in the Red Lacquer Room on this floor. Tomorrow, the joint session will be here in the Grand Ballroom, the Roadmasters' sessions will also be here in the Grand Ballroom, and the B&B will again go to the Adams Ballroom on the sixth floor. Closing session on Wednesday will be here in the Grand Ballroom. That's the bad news. The good news is that we will all be here on the fourth floor in 1988. Now, after all that, we will go on with the conference.

I would like to introduce the officers and directors of the American Railway Bridge and Building Association who are seated at the head tables. In the past we have always said that "those whose duties demand their presence elsewhere will be introduced at a later session". Not so this year. Past board members have volunteered to man the various posts so all could be present this morning. Also in the past we have introduced and introduced and introduced — not so this year. This is it. It is a one-shot deal. Members of the Association, these are your leaders—your officers and directors. These are the people who make this whole thing work. As I introduce each person, I ask that he stand and remain standing until all have been introduced.

Starting on my lower right at the front table, Director Mark C. Walbrun, Manager Engineering Design, Amtrak, Philadelphia, Pennsylvania. Mark is sponsor of Special Subject No. 4.

Director Ed Bond, Chief Engineer, Bridges and Structures, Norfolk Southern Corporation, Atlanta, Georgia. Ed is sponsor of Special Subject No. 2 and serves on the Standing Committee on B&B Training.

Director John H. Smith, Engineer Buildings and Facilities, Illinois Central Gulf Railroad, Chicago, Illinois. John has taken over this year as Chairman of Registration and Chairman of the Standing Committee on Equipment.

Past President James M. Williams, Supervisor B&B, retired, Elgin, Joliet and Eastern Railway, Newaygo, Michigan. Jim is Treasurer and, as immediate Past President, Chairman of the Nominating Committee.

Director John J. Horney, General Structures-Construction Engineer, Union Pacific, Omaha, Nebraska. John is Chairman of the Necrology Committee and serves on the Standing Committee on B&B Training.

Director William J. Semioli, Associate Publisher and Editor of Railway Track and Structures Magazine. Bill is chairman of the Membership Committee and serves on the Standing Committee on Materials.

Now once again, starting at my right, Director Byron T. Burns, Steel Bridge Inspector, Atchison, Topeka and Santa Fe Railway, Topeka, KS. Byron is Chairman of Ladies Activities and serves on the Standing Committee on Equipment.

Junior Vice President Ray A. Tallent, Process Engineer Structures, Norfolk Southern Corporation, Atlanta, Georgia. Ray is Chairman of Special Subjects and also serves on the Conference Program Committee.

Junior Vice President Donald J. Lewis, Senior Structures Designer, Illinois Central Gulf Railroad, Chicago, Illinois. Don is Chairman of Special Features Committee and also serves on the Conference Program Committee.

Senior Vice President John T. Kapp, Project Manager Construction-Design and Construction, Conrail, Philadelphia, Pennsylvania. John is Chairman of the Conference Program Committee. Ladies and gentlemen, these are your officers and directors. The remaining guests at this table will be introduced at a later time.

I will now turn the rostrum over to Wick Moorman, President of the Roadmasters and Maintenance of Way Association of America. Wick.

President Moorman: Thank you, Don. I would like to join with Don Bessey in welcoming everyone to Chicago and the joint meeting of our two Associations. I hope your trip to Chicago will be very pleasant and beneficial. I think that with the work we have done to prepare the presentations for you, there is a great deal to be derived from our conference. The conference is always an opportunity for people to learn from their peers, to discuss their problems with their peers, both from the railroads and from REMSA, which is a big part of the support of our organization. Maybe these discussions will let you take back some method that will improve productivity, save money, or make your work just a little easier or safer. I told someone last night that as far as meeting people and getting involved with your peers, I'd put in a plug for the REMSA suites upstairs. They are there for people to meet each other.

I'd like to go ahead now and introduce the members of the Board of Directors of the Roadmasters' Association. These people have made my year as President of the Roadmasters ridiculously easy. They are a very good group to delegate to. I do all the delegating I possibly can. So I would like for each of them to stand when I call his name and remain standing and, as usual, will you please hold your applause until all are standing. Beginning way down there about where my vision fails, is Director Sam Brunner, Materials Engineer, Illinois Central Gulf Railroad, Chicago, Illinois.

Director Larry Chamberlain, General Roadmaster, Union Pacific Railroad, North Little Rock, Arkansas.

Director Hugh Fuller, Manager-Schedule Reporting, CSX Transportation, Jacksonville, Florida.

Director Steve Hill, Engineer-Planning and Special Projects, Soo Line, Minneapolis, Minnesota.

Director Vince Mahon, Department Manager Power and Way Maintenance, Bay Area Rapid Transit, Oakland, California.

Director Keith Pottorff, Assistant to Chief Engineer, Atchison, Topeka and Santa Fe Railway, Chicago, Illinois.

Director Jerry Cossel, System Production Engineer-Track, Conrail, Philadelphia, Pennsylvania.

Director Mike McGinley, Assistant General Manager-Engineering, Eastern Lines, Southern Pacific Transportation Company, Houston, Texas.

Director John Swiderski, Regional Inspector Maintenance of Way, Canadian National Railroad, Edmonton, Alberta.

Director Al Matte, Supervisor Maintenance of Way, Canadian Pacific, Toronto, Canada.

Director Ken Welch, Assistant Regional Engineer, Union Pacific Railroad, Spring, Texas.

Director Jerry Wood, Chief Engineer-Region, Burlington Northern, Denver, Colorado.

Treasurer Lester Kelley, District Engineer, CSX Transportation, Jacksonville, Florida.

Past President Dave Staplin, Director Engineering Services, CSX Transportation, Jacksonville, Florida.

Second Vice President, Ray Snyder, Assistant Chief Engineer Maintenance, Chicago and North Western Railroad, Chicago, Illinois.

And last, but certainly not least, First Vice President Mike Marlow, Supervising Engineer Tracks and Property, Elgin, Joliet and Eastern Railway, Joliet, Illinois. These are the officers and directors of the Roadmasters' Association.

It always amazes me that when I hear all these titles, you don't ever hear anything like track supervisor or roadmaster or division engineer. It seems like everyone is a manager these days or a planner of some kind.

I'd like now to introduce someone else to come up and make a few remarks unaccustomed as he is to doing so, and that is a gentleman who has always been a great supporter of the Roadmasters Association and, in fact, was a member of our board of directors and now has gone on to even greater heights, I suppose, and that is Herb Webb, the Chief Engineer of the Santa Fe and President of the AREA. Herb.

Greetings from AREA

Mr. Webb: You know, ole Wick forgot something. He's supposed to introduce me as President of the Junior Association because they have found records that say that they are older than we are, the AREA, that is. Anyway, thank you, Wick Moorman and Don Bessey, for inviting me to deliver a few words from your fellow professional association, the American Railway Engineering Association. I want all to know the AREA Board of Directors and our headquarters staff fully support your two excellent organizations. We recognize the important contribution you make to our industry. We believe you do a great deal in furthering the development of the most efficient methods and operations of performing our maintenance and engineering railway responsibilities.

I want to pass to all present, at this 98th Annual Conference of the Roadmasters and 91st Annual Conference of the B&B Association, greetings from the AREA. I would also like to thank REMSA for their support of our organizations. The present officers of REMSA, led by President Ron McDaniel, are a pleasure to work with. I assure you the present REMSA Board is a very aggressive and progressive group. They really are a working group with lots of new ideas and new and fresh methods and they are not afraid to use them.

As most of you realize, we have a regional meeting coming up in Vancouver, British Columbia, on Thursday, October 2. We also have our Annual Committee Chairmen's Meeting the day before and a rail trip on the Canadian Pacific and Canadian National railways on Friday, October 3. The regional meeting is being held in conjunction with the Railroad Week at the Vancouver Worlds Fair so there are many things and many activities going on. So those of you that are attending, I assure you that you are going to have a very interesting and fulfilling experience for two or three days.

Although I believe the regional meeting and Vancouver hotels as well as the train trip are filled to almost their limits, there is always room for a few more. So, if you missed out for one reason or another, talk to us and we will see what we can do.

Let me add one comment about our March AREA Conference here in Chicago. I mentioned REMSA's new progressive ideas. Well, you will be experiencing them in March. The AREA Board of Directors, in conjunction with REMSA, will be presenting a new format in conjunction with a supplier show. We will start our conference sessions a little earlier and maybe run them a little later each day. This is much like we would do in our normal workday instead of as our meetings in the past. Thus, we will have time during a couple of days for the mini-show presentation. We think you will like it. Plan on coming and seeing the new format. One last serious issue before I quit talking. As most of you know I am an advocate of railway research. I am involved with several AAR committees as well as the AAR Board's Research and Executive committees. I firmly believe we need more research conducted for our bridges, track, structures, and every other phase of our industry. We do improve in our methods of doing our work, and we improve in our materials, but we have little except trial and error in conjunction with some engineering theory on which to base these improvements. We know little about today's loadings on our track nor the effects on our track and structure geometry from today's train configurations. We do know how these heavier wheels affect our structures and all other track components. We know we have rail, ties, ballast, subgrade and structure problems but we only know cosmetic solutions. And even with these solutions we don't know how to predict them beyond our ability to inspect our properties.

The only organization equipped, organized and staffed to perform this research is the AAR. None of us railroads, at least us moderately-sized railroads, can afford the research costs nor staffs it would take. I feel the only way to make these research engineers more valuable is for active railroads to work with them in the development of solutions to our problems.

Thus, it is up to us railway engineers to become involved in AAR research. We need to make sure that they are performing the research we want and need to assist us in our daily maintenance operation. We need to make sure their research is solving current and future problems, and that it is being performed for practical use and not to develop further research. We need to assist in getting funding for this research by backing the AAR in their research efforts. We need to help advertise the value of their work to our bosses so that they understand our needs and just what the AAR is doing for our industry. These are the only people who can help us get our maintenance of way research increased to a level that will help us do our jobs better, easier and more economically.

I solicit your help in this effort. Talk to your bosses at every opportunity to express your knowledge and desires in increased maintenance of way research.

Let me close by saying I want to congratulate the Roadmasters' Association and the B&B Association on the fine program that we are all going to enjoy over the next two and one-half days. It looks and sounds very informative. I know the work each board member of both associations as well as the presenters themselves have put into these programs. This work alone will make those very valuable presentations.

Once again, thanks for allowing me to say a few words and I guess we all know me by now — that a few words get to be more than a few.

Thank you.

President Bessey: Thank you, Herb. Now you have heard from a third party about the theme of getting involved in your railroad organizations. Herb, of course, as president of the AREA these last six months has filled the pages of Track and Structures with support for these organizations. If you notice, Herb is wearing three pins in his lapel. He belongs to all three associations.

The Railway Engineering Maintenance Suppliers Association this year, as they have in the past, contributes so much to the success of these conferences that it is difficult to imagine what the conferences would be like without REMSA. It is my pleasure to introduce Mr. Ron McDaniel, President of Burro Crane, Incorporated, President of a couple of other corporations, and President of Railway Engineering Maintenance Suppliers Association. Mr. McDaniel.

Greetings from REMSA

Mr. McDaniel: President Bessey, President Moorman, special guests, ladies and gentlemen. As President of REMSA I am honored and want to thank you for having been asked to join in welcoming the 91st annual conference of Bridge and Building and the 98th annual conference of Roadmasters. That is an impressively long and continuing series of conferences. There are few groups in the association field that can boast of the longevity of the Roadmasters and Bridge and Building. The members of REMSA join me in congratulating you and wish you a productive 1986 conference for everyone and that the stay of all delegates be a pleasant one. If the officers and directors of REMSA can be of assistance in any way please let me, or any of our directors, know. We hope to see all of you at the annual REMSA reception in the Grand Ballroom this Tuesday evening. There will be refreshments, hot and cold hors d'oeuvres and music. If you have not picked up your tickets, they will be available at the REMSA table which is just outside in the hall, located near the registration area, and we will be open today and tomorrow. Complimentary tickets are available for registered railroad personnel and their spouses. The reception hours are from 6:30 to 8 p.m. We are all looking forward to seeing you there. Once again, thank you and have a very good conference.

President Bessey: Thank you, Ron. For many years I have listened to the Association Presidents praise REMSA for their generous hospitality. However, I don't think there is any relationship between supplier and user in any other industry as unique as the relationship between REMSA and the railroads and the railroad organizations.

At this time it is my privilege to introduce our keynote speaker for this opening session. It has been the custom over the years to alternate B&B and Roadmasters, and have the respective President ask the president or vice president or an officer of his railroad to deliver the keynote address.

On June 30, 1985, and after 36 years with the Milwaukee Road, I retired under an "early retirement plan." It must have been a very good plan because 172 officers of the Milwaukee retired on that same day, including the president and vice presidents — all my keynote speakers. However, I decided that I wanted to continue to work, only on a self-employment basis. This is what I have been doing with Envirodyne Engineers, doing as much railroading as I ever did. It, therefore, seemed appropriate that I ask an officer of that company to deliver the keynote address this morning. This officer is Marshall Suloway, Senior Vice President of Envirodyne Engineers.

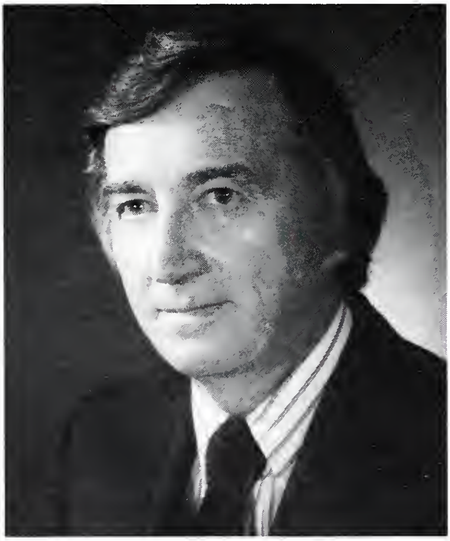
Mr. Suloway received his Bachelor of Science degree in Civil Engineering from Illinois Institute of Technology, went to work for the State of Illinois, Division of Highways, as Staff Engineer, 1950-1956; Assistant Expressway Engineer, 1956-1961; Expressway Engineer 1961-1961; and District Engineer 1961-1964. Then in 1964, he went to work for the City of Chicago as Chief Transportation Engineer, 1964-1966; Assistant Chief Engineer Design, 1966-1967; Chief Engineer, 1967-1973; and then Commissioner of Public Works, City of Chicago, 1973-1979. My first contact with Marshall was during his tenure with the City of Chicago. He constructed a new runway at O'Hare Field which directed air traffic over the Milwaukee Road's Bensenville Yard. A few problems arose, but those were resolved. Since 1979 Marshall has been a senior officer with Envirodyne Engineers, Incorporated, and Project Principal on the reconstruction of the Dan Ryan, Eisenhower, Kennedy, all toll roads in the Chicago area, the billion dollar expansion of O'Hare International Airport, movable bridges, and many railroad projects. He is a member of the Illinois Transportation Study Commission, American Public Works Association, American Road and Transportation Builders Association, American Society of Civil Engineers, International Bridge, Tunnel and Turnpike Association, Illinois Association of Highway Engineers, National Society of Professional Engineers, Illinois Society of Professional Engineers, and the Transportation Research Board. He was one of the Top Ten Public Works Men of 1976, has received two United States Department of Transportation Awards for Excellence, and is a registered Professional Engineer in Illinois, Tennessee and Kentucky.

Marshall was a little concerned about the duration of his address. He didn't know if he could consume that much time. I told him "Don't worry, I'll take up a third of your time introducing you." It is with great pleasure that I give you my co-worker, my senior vice president and my friend, Marshall Suloway.

KEYNOTE ADDRESS

Marshall Suloway

Senior Vice President
Envirodyne Engineers, Inc.



Marshall Suloway

Thanks, Don. And he used a good third of my time, so everybody can relax.

Good morning, railroaders and guests. First of all, it is obvious what a roadmaster is, but not being a railroader, my first revelation was that in addition to meaning bed and breakfast and brandy and benedictine, B&B also stands for Bridge and Building Association.

Having solved that riddle, my next challenge was to find out what a "keynote address" is. Well, here is what Webster's Seventh New Collegiate Dictionary has to say "An address designed to present the issues of primary interest to an assembly and often to arouse unity and enthusiasm."

I would like to attempt to address the latter phrase "arouse unity and enthusiasm" as the basis for my short presentation. There are several approaches that one might use. The pep talk-sweet talk approach is one and the Mike Ditka approach is the other — I'll try the Ditka approach.

Several weeks ago I had the opportunity of taking a train out of New York City north to upstate New York. It was a relaxing, pleasant ride in a comfortable, clean coach on a smooth roadbed. It reminded me of several trips I had made in Canada, Germany, and France in the past few years. Delightful experiences reminiscent of the past; enough so that I bothered to get the following statistics:

Miles of Track — Class I Railroads
1946 — 355,000
1986 — 250,000

Route Miles — Class I Railroads
1946 — 215,000
1986 — 150,000

Number of Employees
1946 — 1,400,000
1986 — 320,000

Number of Class I Railroads
(20 Years)
1966 — 76
1986 — 18

Number of Passenger Train Cars
1946 — 46,000
1986 — 2,500

Revenue Passenger Travel
1946 — 76% of passenger travel
1986 — 4% of passenger travel

Freight — Revenue Ton Miles
1946 — 700,000 million
1986 — 900,000 million

Percent of Total Freight Traffic
1946 — 60% of total market
1986 — 37% of total market

Now, tell me how the hell did we get into this mess?

First of all, let's put a great deal of the blame and shame on you and me — the railroader and the engineer. Over the years we lacked the salesmanship, the finesse to prevent what has happened. How many of you have heard the story about the fella who wanted to buy a half a head of lettuce? It's a story that I have told before, but I believe it really illustrates our short comings. There was a young fellow who was working in the produce department of a supermarket. A fellow came in and said he would like to buy a half a head of lettuce and the young produce clerk said "I'm sorry, Sir. We don't sell lettuce by the half a head, you have to buy the whole head." And the customer replied "Young man, I don't want a whole head of lettuce I want a half a head of lettuce." And the young man said "I'm sorry. We don't sell it that way." And the customer said, "But that is what I want". The young man replied, "Mister, if you look you see that lettuce is on sale for 39 cents a head, why don't you buy a head of lettuce, eat what you want and throw the rest away?" And the man said, "That is the problem with this country today. You young fellows don't know the value of anything. That is wasteful. Young man, go to your manager and tell him." So the young man walked over and found the manager and he said "Manager, there's some dumb ass over there who wants a half a head of lettuce" and he looked around and the man was standing right at his shoulder, and he said "And this fine gentleman standing here wants to buy the other half". Well, the manager caught on right away and the fellow got his half a head of lettuce and left. He said, "Young man, you are pretty sharp. You're fast on your feet. You really think fast. We need people like you around here. I haven't seen you around. Where are you from?" The young man said, "I'm from Toronto." And the manager replied, "Toronto is a great place" and the young man said "A great place? There is nothing up there but hockey players and hookers!" And the manager looked at him and said "Hey, young fellow, watch the way you talk. My wife is from Toronto." And the young man replied, "Yeah, what team did she play with?" Anyway, the problem is that that young grocery clerk is probably an attorney today or an economist, not an engineer.

Railroads were not the only victims of the post World War II era, where our entire infrastructure has been badly mauled. Bridges, for instance, are a good example. I don't think you're supposed to show slides at a keynote address, but I'm going to break tradition.

A recent study indicates that in less than ten years the number of deficient bridges has risen from 24,000 to nearly 230,000 with an estimated cost to cure of over 40 billion dollars. That 230,000 bridges is more than one out of every three. That should not surprise anyone as 72 percent of the nation's bridges were built prior to 1935. Even the newest of that 72 percent are now over 50 years old.

The picture for local bridges is even dimmer — 92 percent predate 1935. At the present rate of spending it would take over 30 years to eliminate all existing deficiencies, not including those that will fall into the deficient category in the years to come.

Let's take a closer look at one of those bridges. This is a general view of a pin-connected Baltimore through truss built around

1892. This is a transit structure.

This is a vertical truss hanger; there is a hole in the outstanding leg at a vertical angle.

Here we have a typical pin-connected joint connecting five members of which only the outer plates are visible with approximately a one-half inch gap between pin and vertical pin plate. This structure is expected to move every time a train passes the joint.

This is a sideview of a pin with an approximate one-quarter inch loss of pin diameter with a hole in the diaphragm plate. Here is a heavily deteriorated floor beam bottom flange angle with an approximately one-quarter inch loss.

This is a deteriorated column channel web with an approximate three-eighths inch loss in web of column channel immediately above base plate. Should this structure be replaced? Of course it should. Will it collapse today if we don't? I don't know. In six months? I really don't know. In a year? I still don't know. But one of these days—any day, if it collapsed with an eight car train loaded to a capacity of 1,200 people, it would make the Silver Bridge catastrophe look like a minor accident. It is obvious that deferred maintenance and reconstruction have taken their toll.

It is criminal what we have let happen to our public transportation system. When the fare box was no longer able to provide the necessary funds to maintain and operate our transit systems, first equipment replacement and then maintenance were postponed. With the advent of federal aid for transit systems it appears that an inordinate amount of funds went for a new system and too little to upgrade existing systems that are in serious need of maintenance and upgrading.

Our thrust as engineers and railroaders should be twofold. First and foremost is management; management to protect and enhance the investment that we have and to continue to build. Second is to insure that we get our share of the pie. Competition for the buck is keen.

Everyone wants to get in on the act. Just 17 years ago public works received 2.5 percent of federal monies; today it is less than 1.5 percent. Seventeen years ago local governments' share for public works was 15 percent. Today it is less than 7 percent and going down.

Even the public works tax dollar is being eroded: Social programs not only for the poor, but for you and me; education not only for the needy, but for you and me. Better retirement benefits, better health insurance, dental insurance, eye glasses and on and on. Reimbursement for undergraduate and graduate work. There is a great demand for the tax buck. The more you cut it up, the smaller the pieces.

Let me view the source of our problems through the eyes of a demographer, a geographer, and a planner.

It all started with World War II: (1) mobility and (2) changing technology. First let us examine mobility although it is hard to separate the two. Defense plants and shipyards brought people off the farms, out of the hills, and from thousands of sleeping towns for patriotic reasons and fantastic salaries, some paying over two dollars an hour. Millions of people who had never been more than 20 miles from their birthplace were now spread throughout the land.

G.I.'s with Uncle Sam as their travel agent traveled the country as well as the world and when G.I. Joe came home after the war, chances are he did not stay long in Bemidji, Minnesota, U.S.A., with the cold winters and the labor conditions in the mines, not after taking R&R in Hawaii.

This migration was aided by the jet aircraft, the new highways we were building, and prosperity. What has this to do with our infrastructure? Plenty. Most of the expenditures were going for new infrastructure and little to maintain the existing.

The 1980 census shows a reverse movement, that is, from city and suburb to rural communities of 2,000 or less population. More infrastructure was needed — more left to neglect. On a different scale, when cities of 50,000 or less find welcomed industry moving in, they find their natural resources and transportation system inadequate to cope. Added services cut the ability to maintain the existing. And let us not forget our senior citizens — sunbelt bound.

Changing technology is another culprit. We have seen a movement of industry from the midwest and northeast not only to the sunbelt but to the Pacific. When industry leaves an area it abandons established transportation systems and public works that must all be maintained.

When the stockyards moved west from Chicago, industry followed those cows. Tanneries as well as dairy products processing went too. Printing once centered in Chicago is spreading throughout the country. At one time it was most important for industry to have rail services, and then came the iron bird. Between the interstate system and the airplane a once priceless infrastructure of rail yards and freight warehousing lies fallow. Industry now seeks highway and air access.

At one time this noble building, the train station, was the center of the urban universe. Now the airport is the magnet that draws corporate headquarters, office complexes, banks, and hotels. Talk about hotels, I could not neglect a jewel from the past. This is the new Michigan Hotel, once the hangout of Al Capone and a short distance from the site of the old Illinois Central 12th Street Station.

Why does industry move? One of the main reasons is low cost labor. Another one is wages and the different parts of the country changing. Another reason is diversification — manufacturing to service. Many say that the era of the tall stack industry is over in the U.S.A. I doubt that, but it is obvious that our steel industry will never be the same and we are becoming a service oriented society. Even our heavy industry is changing to more specialization. There are 185 steel plants in this country but they are specialty mills and located where needed — not centralized in one or two areas as they were in the past; literally cities of steel with rail lines as their life blood.

Industrialists seek out areas where there is military spending and where the political climate is good. They are seeking a better environment to attract good help. We have all seen those ads — palm trees, tennis courts, and bikini clad beauties. And when that environment is no longer attractive it is time to move on. There is a definite tendency toward short term capital investment in smaller plants. Structures and equipment to be amortized in ten years so a move can be made when desired. There is also a move on to reconstruct industry with adjacent housing — back to the industrial revolution.

Communications — with modern telecommunications systems it's no longer necessary to have your bookkeeper in the back room. Citibank of New York has 1,000 plus people working in a computer center in Sioux Falls, South Dakota.

We are building new and neglecting our investment. There is only so much available money.

As previously stated although freight revenue ton miles have increased some 28 percent, the railroads' share of the market has dropped 23 percent. Not only have the number of trucks on the road tripled in the last 30 years but legislation has been pushed through Congress to allow heavier loads, wider and longer trailers. The Corp of Engineers has been doing wonders for the barge operators, while the pipeline companies are doing their thing.

Air freight — it is no revelation to anyone what has happened to the air freight business since the advent of jet aircraft. But let me give you this statistic, and this one hurts, in 1946 the revenue ton miles on scheduled airlines and this doesn't include all those little planes flying all the marijuana and cocaine up from South America, this is on scheduled aircraft, was 53,702,000. In 1985 it was 6,006,254,000 or up more than one hundredfold. So I think it is obvious that we must manage better — we must sell better. If we don't use the hard sell, and, I think Mr. Webb brought out a great point, do a lot of research, and come up to date in the railroad industry, this country may never see a high speed train that will connect the East coast with the West coast, with Chicago as the rail center of the world again. Not unless we do those things.

Along the line we are going to have to sacrifice a little too. Which reminds me of a story about a young golfer. This young fellow didn't play golf, but all his buddies did, so he decided to take up the game. He took up the game and he wasn't very good at it. He was on the 18th green and it was about his fourth or fifth putt and he looked at the cup and the devil came out of the cup. And the devil asked, "Are you having a little problem?" And the golfer said "I sure am". The devil asked "Do you like the game? Would you like to play better?" And the golfer said he would do anything to play better. So the devil said "I could give you a few pointers and I think that within a year you would be a scratch golfer". The young man said "Oh, would I love that". So the devil said, "Well, it will cost you though. The better your golf games gets, the worse your sex life gets. So, what do you think?" The young man replied "Anything — I have to improve my game." Anyway, a year later here the young man is, he is going to one putt on the 18th. If he does, he will be one under par for the 18 and the devil comes out and he says "Hi. How's your golf game?'' The young man replied ''Terrific! I'm a scratch golfer.'' The devil said ''Great. How's your sex life?'' The golfer said, ''Well, last year I had sex four times and this year only twice. But you know, for a Roman Catholic priest in a small parish, that isn't bad.'' (Laughter)

With that, I think I will close and I hope you have a very, very successful meeting and let's get on and do what Mr. Webb said and really do something so we can get back the great United States railroads that we had not too many years ago. Thank you.

President Bessey: Thank you very much, Marshall. You told me you didn't know that much about railroads and therefore, couldn't address the subject of railroads well. But I think you know a lot about railroads. Even so, the next two and a half days we're going to have railroaders up here talking to railroaders about railroads so your message this morning, properly defined, was very well taken.

At this time I will turn the program over to Steve Hill who will introduce the first special feature speaker.

Mr. Hill: Thank you, President Bessey. Our first special feature for this morning will be presented by Mr. Jim Gorley of the Union Pacific. Jim came to the UP six years ago after completing his bachelor's degree in civil engineering at Penn State. He worked as pollution control engineer until last July when he was promoted to B&B supervisor. Mr. Gorley's talk will be about the pollution control system he helped design and install at the Union Pacific's North Little Rock engine facility. I would like to remind you, that in keeping with the spirit of the meeting , ''get involved'', this is your first opportunity. Ask questions when Jim is finished. Jim.

POLLUTION CONTROL AT LITTLE ROCK

James T. Gorley

B&B Supervisor
Union Pacific Railroad

Good morning fellow members of the Roadmasters and Maintenance of Way Association and the B&B Association. I wish to thank the Board members for inviting me to speak on what was at the time a very interesting project and it has proven to be beneficial to us. My subject, as indicated in the program, was a pollution control system that we installed at Little Rock, Arkansas. More specifically, it concerns the design and installation of the pollution collection system in coordination with track improvements at our engine servicing facilities at our North Little Rock shops.

The Problem

This shop acts as one of the principal service points for the UP-MP fleet due to its centralized location in the UP system. Servicing the units going through the shop typically consists of fueling, lube oil changes, sanding, changing the cooling water, as well as inspections. It also includes sanding and sanding has become a problem in that area. Inevitably these products find their way to the ground which, if kept within the confines of the concrete shop floor in small enough quantities, aren't a problem. Unfortunately for the roadmaster, these materials do find their way to the tracks since the engines must wait outside the shop before being serviced and before they are put on trains. And they are in significant amounts because we run 90 locomotives on a typical day through this shop. Left unchecked these fuels and oils contribute to the premature deterioration of the tracks, potentially hazardous working conditions, and environmental problems.

Shown here is the track, the holding yard, before the engines enter the shop area for servicing. This slide depicts the deterioration of the holding yard prior to replacement of the tracks. You can see by the angle at which the locomotives are standing that significant problems at cross level are occurring. At the time this was taken maintenance spots like these were becoming a near daily occurrence.

The photograph that you are now looking at was taken in the same vicinity as the last and shows in greater detail what was becoming of the track. Please note the material on top of the ties was a conglomeration of sand, fine soils, grease, oils, and water which had been shoveled clear so that the track could be spiked back to gauge. This condition promotes the failure at a minimum in at least two ways. One, the spikes cannot grab a foothold in the ties due to the swelling caused by the water and oils being absorbed into the ties. Also, there is a certain amount of biological degradation of the tie which makes it deteriorate that much faster as well as the mechanical wear on the tie caused by pumping against the ballast section. For these reasons alone, they wanted to design an alternative to the present system of just scrapping out the old crude and replacing it with new.

But there still exists the safety and environmental issue. Safety in the work place is the foremost concern of the Union Pacific/Missouri Pacific System and it was therefore a major consideration when evaluating the needs for improvement of these tracks.

In this slide I ask that you note the deterioration of the work area. This section which was replaced in 1985 was estimated as six years old at the time the picture was taken. This condition, notably the greasy tie surface, subjects the employee working in the area to an increased chance of injury. There not only exists the obvious walking hazard but also the possibility of picking the oil up on tools and other working surfaces where loss of grip can prove disastrous. Imagine for a moment what it would be like working in this area. At the top of the photograph you can see some ponding becoming evident which is further depicted in this photograph. These puddles consist primarily of ponded rainwater, engine coolant, and diesel oil. And the last upgrade of this area — perforated, bituminous, corrugated metal pipe risers — were installed to collect the surface water and some portion of the ground water. These basins were connected to an existing oil/water separator and storm water equalization basin for treatment of the runoff water. This system was designed such that oil contaminated storm water collected in this area be treated to meet the requirements of the Federal Clean Water Act and Environmental Regulations in the State of Arkansas. As you can see, engine sand fouled with oils and greases have disrupted the flow pattern of the water to the surrounding catch basins. During periods of high rainfall standing water levels would rise until they would reach these sand dams and drain to the catch basin. As you would expect, this is a most undesirable time to have to work in the area.

The standing pools represent a potential environmental problem in that they allow time for oils and water to percolate into the soils where they can come into contact with the ground water table. This photograph was taken during the 1984 portion of the rehabilitation program. In the upper right hand corner you can see the exiting end of the service shop facility. The lower extent of the shadow is the grade line of the excavation for the new system. The dark area extending approximately four to six inches below the bottom of the tie denotes the migration of the pollutants and the environment in which ties are expected to perform.

At this point I would briefly like to recap three points that I am trying to make: (a) that tracks need replacement due to their deteriorated condition; (b) significant safety problems were arising due to the footing hazards primarily; and (c) environmental issues as depicted here.

Pollutant Collection System

Shown here is an approximation of the added pollutant collection systems function into the existing storm water treatment facilities. The locomotives and holding tracks along with rainfall constitute the widespread sewers. The new collection system serves to consolidate the oil contaminated surface waters and to separate off the heavier, coarser contaminates. The oily, greasy sand is consolidated and hauled in an appropriate facility for disposal. If it were allowed to enter into the piping and basins of the storage and treatment facility the greasy sand would more than likely reduce the hydraulic efficiency of the piping and retention basins and promote wear on the lift pumps. Drainage piping within the confines of the service facility exhibits this condition.The consolidated storm water drippings from the new collection system are then transported via the previously existing network of underground piping to temporary storage and sewage basins. This basin serves a twofold purpose. Primarily it performs a function of retaining a rapid influx of contaminated storm water from the collection system until the more moderately-sized treatment facility can process it. Secondly, the effectiveness of the treatment process is a function of time. Meaning, basically, that the longer the oil and water mixture has to set, the more effectively it is separated and therefore the cleaner the water.

Treatment of the water from the sewage basin consists of metered injection of an oil/water emulsion-breaking chemical and additional gravity separation through a baffled tank. Oil, which is accumulated in this process, is skimmed off the water surface and transferred to a bulk tank for sale. The clarified water is discharged to a conventional storm water flow equalization basin which discharges to a public waterway under a national pollutant discharge elimination system permit. This permit requires that the water exhibit not greater than a daily average of 15 milligrams of oil and grease per liter of sampled water or that it does not exhibit a visible sheen. In more visible terms, this relates to a faint discoloration of the water when contaminated with weathered number two diesel fuel.

As I mentioned earlier the collection system served a dual purpose capturing storm water and engine drippings while separating out the coarser and heavier materials.

How It Functions

Our graphics department and their computer-aided drafting equipment prepared this representative cross-section of the collection in relation to the track structure. In essence, you are looking at a railroad track built on top of a french drain. There is one significant difference. Water can only enter this drain from above due to the addition of an impermeable oil-resistant polyvinyl chloride lining. In essence, this idea is not original. Some of you may have seen it used on other railroads and some of the manufacturers' representatives are probably aware that a comparable system has already been designed. However, we adapted it more for our ready-stock materials and our condition.

The fine orange line in the lower portion of the drawing represents a continuous sheet of oil-resistant polyvinyl chloride with a single layer of 18 ounce per square yard polyester geotextile for protection. The ORPVC in its composition can be compared to a common household garbage bag that is substantially thicker, being on the order of approximately 30 times. This liner is a continuous membrane that runs from ground surface beneath the track to the other side of the track back up to the ground surface and, additionally, along the length of the track. This particular product is manufactured in five foot widths, then welded to a 20 foot width to fill our excavation. We used sheets in 200 foot lengths then connected those with a vinyl adhesive in the field.

By laying this liner from ground surface to beneath the track and back up to ground surface again we hope to isolate the non-contaminated ground and storm water from that which falls directly on the track. To prevent buildup of ground water in this area, perforated risers were set outside of the confines of the plastic but still tied into the collection system. As you might expect this does contribute to the flow of water through our treatment plant and thereby the cost, but it would have taken additional underground piping to keep the two waters separated. A six inch perforated corrugated metal pipe is indicated in the lower left portion of the cross section. This pipe carries the trapped water into a 24 inch manhole which is a portion of the former network. These manholes are typically set at 400 foot intervals along the length of the track. The three to five inch sized stone fill was used to provide for extended life of the voids. Conventional pea grade ballast being on the order of an inch diameter was used to top the three to five inch stone since the stone was unsuitable for tamping.

The orange line on top of the tie is an additional layer of 18-ounce geotextile in the newer phase of the project whose function was to filter out the sand, heavy greases, and coarser solids and thereby keep the voids clear. As I said, in the 1984 phase we used a lighter weight fabric on top of the ties. It was 6.5 ounces per square yard which we changed to an 18 ounce weight fabric, the reason being that it was felt that when it came to the cleaning process, the heavier fabric would hold up better due to higher tensile strength. Thicker has an estimated vertical water permeability of 249 gallons per minute per square foot which allows moderate rainfall to pass through readily. Finally, this is covered with a thin layer of gravel to provide for footing on the oil-slickened fabric. The total cost of the two combined projects included 14,330 feet of track and 31 switches and was in the neighborhood of $1,995,000. Approximately 19 percent of that went to the added excavation of 10,400 cubic yards for the collection system and 264,000 square feet of fabric and geotextile ORPVC spread over the area.

This photograph was taken in the early stages of the 1984 portion of the project. The track on which the locomotive is standing and the one to its immediate left ended approximately 100 feet from the exit end of the service building. Therefore, this area is the first subject to drippings from the freshly serviced engines. The puddle of oil leaks from that remaining track on which the engine sits. In the upper left corner is the ORPVC being placed. It has not yet received the geotextile for the six inch perforated pipe. The liner was shipped to us in these boxes and came in 20 foot by 200 foot sections, four to a box. These sections were folded first across their width and then along their length accordion style, so when it came time to place it, the material could be unfolded, unraveled from the box back up to 200 feet and then pulled out by a four man gang and spread out over the area and then glued to the other pieces of ORPVC.

This photo shows a six inch pipe in place and the geotextile ready to be applied. Please note the pliability of the material and how it must be anchored to the top of the slope. The yellow line up to the left along the left edge of the plastic is one of the factory welds and on top of it is the six inch perforated pipe and it is sloped toward the top of the photograph. The geotextile had to be laid, each row side by side to cover the area.

Next, the three to five inch stone is applied. As you might expect, the stone had to be delivered in dump trucks with 14 to 18 ton capability due to maneuverability on the site and their ability to drive over this type of surface. A small dozer was then used to grade the site out.

I provided this slide of the 1984 portion of the project to give you a better idea of the scope. This represents 27 percent of the combined efforts of the 1984 phase and 1985 phase of the work.

As I said earlier, the yellow stripes on this plastic were from the factory welding process. These sheets, as you can see, are the 20 by 200 foot sheets, ready to be glued in the field. An access road for the trucks to get in and out of the site to haul the excavated material is there at the end of the furthest sheet toward the top of the photograph.

In this shot you can see the dozer spreading out the three to five inch stones as the truck dumps it. Note the rutting to the left of the truck. This was caused by the numerous trucks using the area to deliver the stone and then exit. To remedy this, we brought the trucks in from the side of the excavation to drive them across the pea stone and dump. Then the dozer would push the stone out onto the plastic surface. Not shown in this picture are the new panel tracks being laid off to the lower right hand end of the picture. The green tank to the right side of the picture is the location of the treatment facility. We had 24 inch corrugated metal pipe running perpendicularly to the new facility and off to a 36 inch pipe which ran down this road and into the treatment facility. Here is the same site two years later. It appears justified to say that the oil and water are being captured within the edges of the collection system by the well-defined line between the clean and oily ballast. The fabric cannot be seen due to the gravel walking surface that we applied.

Current Problems

There seem to be two problems in this photograph. First, we have this area where the engine is and the end of the turntable which we did not replace with the geotextile fabric to see how it would perform compared to the existing method of rehabilitating. You can see the oil running off into the turntable where we had a drain which was also tied into the treatment plant. Secondly, the two tracks to the left appear to have oil running between them. The oil appears to have run off from this crossover track towards this engine rack because of the lighter shaded areas where the oil appears to have dropped down into the line. This area hasn't required routine maintenance since its installation, but it has experienced a few minor derailments due to the switch point protectors.

These are some of the engine holding tracks replaced in 1985 and this is a view looking in the opposite direction from that first one where the engines were leaning. The large accumulation of sand is caused by testing of the sanders under emergency brake applications before the engines are put on trains. The photo was taken after a day of significant rainfall and does not show the ponding that was previously present in the area. It appears, though, that the sand should be removed since the ballast between the adjacent tracks is becoming discolored from oil and water running off the fabric. In its present form the cleanup of this sand from these tracks would be a labor-intensive task since the track cleaner would likely damage the fabric and the fabric could get wound up in the track cleaner.

This is a close-up of those same tracks from the last line with the portion of fabric pulled back to show the ballast surface below. This also demonstrates the need to remove the sand that is beginning to overflow the fabric and migrate into the ballast. Please remember that this fabric was installed one year ago and is in that same area as the puddled sand-filled tracks shown at the beginning of the presentation.

Summary

In summary, I would like to recap the benefits and drawbacks of the pollutant control system. Under benefits, we have reduced maintenance, increased tie life, and, due to increased tie life, improved drainage. We also have a reduction in derailments which implies less need of repair to damaged tracks, less delay to locomotives before being serviced or while awaiting to be put on a train and therefore, a better utilization of our labor forces. They are not out picking up derailments or repairing track. And thirdly, the control of pollutants. One thing I did not mention here is the safety factor. Of course, you can see from those photographs, although there is still some oil and sand left on the tracks, it is a better walking area. It is not as slippery and you do not pick up as much oil as you formerly did, and if the fabric is kept clean, it should not be a problem.

Under drawbacks, we have the duration of the installation and the inconvenience it places upon the mechanical forces on getting engines in and out of the service track and the delays caused in switching them; also the lack of storage area for them. Secondly, we have the cleaning of the geotextile surface. As I said, in its present form, with just the geotextile and a thin skin of gravel you virtually have to go in there by hand and dig it out which doesn't help that labor force argument. However, we believe we have found one possible solution to it. And it is similar to this. This was a crossing we had put in using one inch grading like you would use on tank car loading platforms and whatnot. If you can envision laying out your fabric and then tacking this down on top of it, and then allowing the sand to go ahead and fill it up, you should be able to run a track cleaner across this without damaging your fabric. It would only leave approximately an inch of sand, which still should readily pass the water.

Well, at this time I would like to answer any questions you might have about it. Can we have the lights back, please? Thank you.

Member: What do you do with the oil and material that was excavated?

Mr. Gorley: Of course, there were two materials left over. There was the oil and the regular fill below it. The oily material went to a suitable landfill in the State of Arkansas, licensed by the State of Arkansas, and the contractor doing the excavation bought off the excavated clean fill.

Well, if there are no further questions, I would like to turn the program back over to President Bessey. Thank you all very much for your time.

President Bessey: Thank you very much, Mr. Gorley. I was just sitting here thinking that 25 years ago we didn't have this type of control. We didn't have pollution control systems. We didn't have environmental departments, but then the local, state and federal governments brought on these regulations, and I have to think that we in the industry probably brought this problem on ourselves by not keeping our house clean. But the positive side of this picture is I think that we, as a railroad industry, are doing as good or maybe even a better job of cleaning up the environment and solving these environmental problems than any other industry. So I think we have to be proud of our industry.

Earlier I introduced one of our directors, John Smith. John's mother has been ill for a long time and I'm sad to report that she passed away this morning. So we extend our sympathies to John.

We're going to take a short break and will reconvene back here in about 10 minutes.

President Moorman: Everyone please be seated. I would like to call this session back to order and we'll continue with the program. Steve Hill will introduce our next speaker.

Mr. Hill: Thank you, President Moorman. Our speaker will be Roy Smith, Superintendent of Power and Way for the Chicago Transit Authority. Mr. Smith started with the CTA in 1964 after receiving his Bachelor of Science in Civil Engineering from I.I.T. He is a registered professional engineer, a Fellow of the American Society of Civil Engineers, a member of the American Public Transit Association Track Construction and Maintenance Sub-committee, and a member of the Transportation Research Board's Task Force on Rail Transit System Design. Mr. Smith's topic will be Track Rehabilitation and New Construction on the CTA. Mr. Smith.

TRACK REHABILITATION AND NEW CONSTRUCTION ON THE CTA

Roy T. Smith

Superintendent Power and Way
Chicago Transit Authority

Thank you Steve. After Marshall Suloway's keynote address it is rather hard to tell a story, but I'll try.

We had a retired trackman come back to visit us last week and on his way home, he started crying and everyone ran up to Joe and asked him why he was crying. "Did your wife leave you?" Joe said "No, my wife didn't leave me. I've been married for two years to a girl who is 22 years old. Christie Brinkley type." "So, Joe, why are you crying? Doesn't she cook very well?" And Joe replied, "No, she cooks fantastic, French, Italian, whatever." "Well, Joe, doesn't she take care of the house very well?" "No, she is a great housekeeper." "Well, Joe, maybe your nights are not as good as they used to be?" Joe replied, "Now, don't even talk about it. Every night." "Well, we don't understand Joe, why are you crying?" "I forgot where I live" he says. Anyway, let's get into this.

CTA. What is it? CTA, Chicago Transit Authority is both a rapid transit and a bus service. A rapid transit system and a bus system which has a daily ridership of over two million people. The bus system operates and maintains over 2400 buses and much could be written about the many problems associated with this, but this report will deal only with the rapid transit system and specifically the track portion.

CTA Track

CTA's rapid transit system has over 257 miles of track. Sort of a small Tooterville Trolley compared to some of your railroads out there, but we try to manage. Our track has 24 miles of subway; 95 miles is open deck elevated and 138 miles is ballasted. Located on the track system are 143 rapid transit stations, 21 of which are in the subway, 64 on open deck elevated, and the remainder on ballasted track, either at grade or embankment. Here again much could be written about the many problems of designing and maintaining stations, but we will leave that for another time.

Twenty-four miles of subway track consist of basically three types of construction: ballast and tie, either concrete as shown here or timber; timber half-tie embedded in concrete invert and direct fixation pads; and steel and rubber composition attached to concrete invert. The 95 miles of open deck elevated is, for all practical purposes, one type of construction—a pine timber tie, hook bolted to the elevated structure with standard rail and track fastenings. The one big difference between this construction and standard railroad construction is the addition of two types of guards: two steel inside guardrails and two outside timber guardrails. This type of construction at CTA goes back to the turn of the century and has changed very little. The 138 miles of ballasted track can be compared to any long line railroad construction. CTA has both concrete ties and timber oak ties. The concrete ties and supporting limestone ballast, however, have been deteriorating since their installation in the late 1960's and, as a result, they are presently all being changed out. One thing that must be noted about CTA track construction is the 600 volt DC powered third rail which ads one element which railroads generally do not have to take into account during rehabilitation. Because the existing CTA track system is so different, original construction over 90 years old, this has made it quite difficult to specify new construction. Do we install something new which is turn of the century design just to make it compatible or do we look at a new system, as in Washington or Miami and design it that way? Since the older designs are generally noisier than the new designs, the tendency has been to lean more and more toward the new type construction used in San Francisco, Washington and Miami. Design which must address noise and vibration control must also, however, lend itself to maintenance and provide an easy method for major renewals in future years. Daily or routine maintenance on most of the new and existing transit properties is generally no big problem, the major replacement of various elements of a track system can be, or will be if not considered during design. An example at CTA on just how difficult this can be is to look at one of its old subways built in the early 1940's. All CTA subways are two track construction. Aside from being very noisy, they have timber half block ties embedded in concrete, which in some cases, have been spike killed or have rotted from dampness. There is no easy way to solve this problem unless the entire line is shut down for some extended length of time. The CTA operates 24 hours a day, 7 days a week, with maximum off-peak train headways of only 10 to 15 minutes on some routes.

Track Renewal

To give you an idea of some other maintenance problems, let's now look at what is required to renew our open deck elevated structure track. This, like nearly all of our system, is a two track system. Maintaining traffic on a two track system and performing renewals can be rather difficult. There are a number of different methods to renew open deck elevateds. But the following steps are typically used at CTA.

Preliminary stripping of the track includes removal of the two steel inside guardrails which are scrapped. Next the removal of three of every four gauge side spikes and the partial pulling of the remaining spikes is done. Once the track is stripped, running rail is delivered and at the same time, the scrapped steel inside guardrails are removed. The new running rail is then bolted together in place between the existing running rails for changeout during a single track operation which is generally on a Sunday. Since CTA never stops operating, the only way to take a track out of service is to reroute all train traffic to the other track. The rail change is next. It starts with the cutting of the existing rail to be removed into short lengths. The old rail is then thrown between the new rail and is followed by the immediate installation of the new rail. Once the new rail is in place, the last section of rail is field sawed and drilled to fit.

Following a rail change, the third rail is adjusted to compensate for the new running rail height. Once the running rail has been installed and the third rail adjusted, the installation of the remaining ties and fastenings can take place. The next phase of construction is timber tie renewal and is all done under train traffic. The first step is the removal of the outside timber guards in the area of tie replacement and the removal of the hook bolts, tie plates and spikes of the ties to be replaced. Every fourth tie, which is always hook bolted is left in place and gauge rods are installed to keep the rails from spreading as trains pass. Bear in mind that this is all done under train traffic. Train speed through the construction zone is naturally slowed to an approximate speed of six miles per hour.

Hook bolts are used to fasten the timbered tie and the steel structured top flange angles. Two hook bolts are used per tie and typically every other tie is hook bolted. In curves and special track work we hook bolt all the ties except for the ones that hold the third rail supports.

Following the stripping, the rail is jacked and the old ties are removed and replaced. Not one for one, though, because we have changed our tie spacing from 18 inches to 24 inches. Once the ties have been installed they are immediately hook bolted, every other one to the top flange angles of the supporting steel structure. Following this, new tie pads, plates and spikes are installed, followed by the removal and the replacement of the remaining old gauge ties.

The last step is the installation of the outside timber guards, running rail anchors and replacement of the steel inside guards. The only running rail is used for the steel inside guards. Finally the installation of rail joint bonds is completed. These bonds are used to make the running rail an electrical conductor for purposes of signaling and negative return. The rate of renewal is quite slow. One of our structured track gangs, we have four total, renews approximately 30 to 35 feet of tangent track per day working year around. For curve renewals, we average only 10 to 15 feet per day working year around. Ten feet a day. That's not very much. It is really difficult. Major replacement of track ties is scheduled for a 25 year cycle; while running rail is 40 to 50 years for tangent and as low as 10 years for some of our tight radius curves. Our costs are typically $200 per foot for tangent track, that doesn't include any third rail or footwalks, and as much as $350 to $400 per foot for guarded curves.

Ballasted Track Renewals

Ballasted track renewals are an entirely different problem. Up until only a few years ago, CTA had never done major ballasted track renewals. So this created a real problem on how to maintain train traffic. For our first attempt at this problem we took the easy way out. We chose our only four track system to renew. During this section of track on our north side mainline between Lawrence and Howard, we hoped to get some experience which we would be able to use on our two track systems. While this was a four track system, it should be noted that the tracks were on a raised embankment and not at ground level which would have made the job a little bit easier. The following steps were used in CTA's first major ballasted track renewal. Please note, again, that this was our first attempt at anything like this.

The existence of a four track system, two of which were local service, and the other two for express service, made it possible to remove one track at a time from service. This was done with a series of temporary switches and curves and, where necessary, temporary platforms. Passengers had complete access to the rapid transit system at all times. Once the track was removed from service, the first step was to remove the old track to a depth of 12 inches to below the bottom of the tie. The subgrade was compacted with a vibratory compactor, followed by placement of new limestone ballast which was compacted in five inch lifts. The ballast is AREA No. 4, although our new standard is AREA No. 3. It should be noted that our new construction standard also uses a filter fabric on top of the subgrade before placement of ballast.

The next phase of work was to build a track which included oak ties with two foot center spacing, and 115 pound RE continuous welded rail. Welds were made by the electric flash butt method and field connected with a thermite process. This shows some of the work that was involved to get to this stage. You'll notice that we don't always crop the rails. We have not had a problem with the thermite welding of the rail with the joint bar holes. Ballast dressing follows. This is a modern day ballast car fleet — one car. We actually have two.

Something of interest was the delivery of the CWR. This was our modern welding train. It was composed of old flat cars and old transit cars. We could handle two rails at a time and the length that we could carry was dictated by how much equipment we could gather, and it was 468 feet — twelve rails. It was welded at various sites around the country, it was brought to our Skokie shops, and from the Skokie shops we put it on the train and ran it out to the job site, pulled it off the train and into the track.

Once the track was completely built, the 600 volt DC power rail was installed, followed by final tamping and profiling. It should be noted that the track equipment, like much of CTA's equipment, needs to fit CTA's tight clearances and restrictive track geometry. We have curves of 90 foot radius, that's a 63.6 degree curve and we have No. 3-1/2 turnouts.

Finally, the rail is ground using our rail smoother to remove rail mill scale and imperfections. This smoothing is also done on our elevated structure track, under traffic, between revenue trains. This method is used because we can do it without interrupting train service. It takes a fairly long time, but it gets the job done. Most of the grinding trains in your single track, they are slow and probably do a better job. I won't deny that, but this does an adequate job for us. We run it in revenue service, maybe 100 trips over a week or two, but it does get the imperfections and the corrugation out. We have to do this about every two years.

New Designs

Turning away from elevated and ballasted track construction, for a moment, let's look at some new designs at CTA and some of the reasons why improvements are necessary and desirable. Elevated track at CTA has timber pine ties which have a useful life of 25 years. That's one of our ties. You can see the tie plate on that particular tie. You can really appreciate some of the old stuff. We don't have too much of this around any more. The capital program with federal funds has really helped us upgrade our system. But this is the way it looked a few years ago. Use of rubber rail seats or resilient fasteners give a longer life, and with the right fastener, could reduce noise and vibration, very important at CTA. Resilient fasteners are typically bonded steel plate and rubber fastened to a concrete invert in subways or to the concrete deck in elevated portions. These are also used for special projects. In this case we used it to isolate the running rails from the elevated structure. We needed to keep them isolated. Elevated track at CTA typically uses bolted rail; a maintenance problem as well as a noise problem. Welded rail in short lengths have been installed on our system, but there is so little known about this that we have been reluctant to use this as a standard. Using a concrete deck could solve this problem, but then a whole new structure system is required. CTA's existing subway is either very old, 40 plus years in the State Street subway, or very new as shown here in the O'Hare subway. If anyone hasn't seen the O'Hare subway station, it is worth the trip just to go over and see it. It is our showcase.

The old system as noted earlier in this report, uses timber block half ties embedded in concrete. Even though this system is old, continuous welded rail was used in the original construction. This would normally provide a quiet system but the overall design does not and, as a result, the system is very noisy. Another problem is that the running rail will be renewed in the next few years, and because the timber ties cannot be removed or replaced easily there is concern about the integrity of the wood under the rail base as well as the holding characteristics when the new rail is laid and the ties are already spiked. The new type designs which use steel and rubber composition pads eliminate the wood problem and the rail can be easily changed out because of the threaded rail holdout clips. This again, is in our new O'Hare subway.

Complete Ballasted Track Renewal

Returning to major track renewals, you have probably been wondering if CTA ever did a complete two track ballasted renewal project? Well, the answer is yes, but how did we do it? The answer is quite simple. Shut the line down and use buses. Seems like the easy way out, but when the entire picture was analyzed, a clear picture developed. The track that was renewed was a two track ballasted embankment on the Lake Street route between Laramie and Harlem along C&NW tracks. Proposals that were considered were renew as much track as possible under single track on long weekends. This was a scheme that would take over a year to complete. The passengers would be inconvenienced the least. This scheme would require CTA forces to completely remove and install approximately 500 track feet from a Saturday night to a Monday morning. It was true that passenger inconvenience would be the least, but the potential of many major Monday morning rush hour disruptions was a good possibility due to either bad weather or broken down equipment. There was also consideration given to the extreme pressure that would be placed on the workers and supervisors over so many consecutive and long weekends.

The other plan was to remove one track at a time from revenue service and run trains on the other track, but only during and in the major rush hour direction. Buses were used to transport people when no trains were running, such as weekends, non-rush periods, and against the rush hour flow during rush hour. This scheme saved an estimated two million dollars and although some passenger inconvenience was experienced, the construction schedule was reduced to only a few months. This scheme eliminated all potential problems that were noted in the one above. The following slides depict this construction: this is part of a diamond that we manufactured off the site and just carried into and placed in the track; some of the rush hour trains; first modern day equipment — a switch undercutter. Please note the filter fabric that we are using. Here is the completed track.

The next slides will show you our Dan Ryan track renewal project. I mentioned the concrete ties earlier, and the limestone ballast, and some of the failures we were getting. We are finally now into a program of replacing all 54,000 concrete ties. We're not blaming the concrete ties, we are blaming the system. We feel the soft limestone that we used was just not compatible or maybe the tie spacing of 39 inches, or whatever it was, just wasn't a good system. As a result, after a few years, they were starting to pulverize. Pumping action in the track was severe. So we are finally into this particular job. To do this we have hired a contractor who is utilizing upwards of 116 men on long weekends, from a Friday night to a Monday morning on single track. He's using three shifts, working around the clock.

So I'll show you some of the problems that we got into. Please note particularly where this is being done. It's in the Dan Ryan expressway, one of the busiest expressways in the world. We didn't do the ballast completely. We're doing all the ties, but we are only doing about three to four miles of ballast out of 30 miles of track on the Dan Ryan and Kennedy. It's strange, but not all the areas have totally disintegrated. Some areas are pretty good but there is evidence that it is leading to deterioration. As a result, we are changing all the concrete ties.

This gives you an overview of some of the equipment the contractor used in some of the areas where he had to change out ties only. Note that some of the areas in stations are rather difficult; a lot of hand work.

Bridge Renewal

Earlier Marshall Suloway talked about bridges, and this is for the bridge guys who may have gone to sleep. You can wake them up now. Marshall showed the same picture, in fact. I thought he was going to steal my thunder. I've got a few slides on how we actually went through and did this bridge. It was on a long weekend. We actually cut service, rolled the bridge out, and built a new one next to it. There is the old one out of the way and the new one getting ready to come in. Here is the new bridge rolled into place. Some additional steel had to be erected and some ties placed on it. Then we had a completed bridge on one long weekend. It took a lot of preparation but it was done.

Are there any questions?

Member: What radius do you get the CWR around?

Mr. Smith: We try to keep it at 150 foot radius, but one of the foremen of the work train ran it around an 89 foot tight radius loop. It did a lot of damage to the equipment, but the rail went around it, didn't crack, straightened out when we brought it back out. We wouldn't do that by design, but we did do it.

Member: Typically, what are the axle loads that you have on your system?

Mr. Smith: I think they design for a 75,000 pound carload and divide it by four; so whatever that is. Fifty thousand pounds is the deadload of the car and 25,000 pounds for liveloading.

Member: When you replaced the Dan Ryan ties on a system what considerations did you give for concrete versus wood versus other systems that you had taken a look at.

Mr. Smith: Bear in mind that we had a system that was falling apart. We can get commercially available limestone. It is our opinion that limestone and concrete ties are just not compatible. We pursued getting granite through one of the local railroads, but the cost was about three times as much, the handling was difficult, and then the railroad couldn't guarantee it because they had their own jobs. So we pretty much, as of today, have ruled that at CTA we don't use concrete ties and it is strictly because of the granite or some harder rock that we can't get, and that's basically the reason that we've gone back to oak ties. That particular job you saw there — I didn't mention the cost, but we're looking at about an eighteen million dollar expenditure just to change out those ties and change out ballast over three to four miles. Now the 30 miles of track, when it was built in 1968 and 1969, was about an eleven million dollar contract. So one of the things that I stressed was the fact design has got to really take care of the maintenance, and if you don't consider it up front, you are in big trouble. Thank you.

Mr. Hill: Thank you, Roy. That certainly gave me pause when you quoted your production rates for your tie changeout on the bridge decks. I don't think my general manager would accept anything close to that on some of our tie gangs.

Our next speaker is Mr. Jim Hunter from the Federal Railroad Administration. Jim started his railroad career as a trackman on an extra gang in Pilot Grove, Missouri, on the day after his 16th birthday. He subsequently worked on the section during the summer months while going to school. Jim is a graduate civil engineer of the University of Missouri at Columbia, and served as a commanding officer in the Army Engineers during the Korean War. His experience includes work as a rodman and chainman in survey party, assistant engineer, roadmaster, assistant division engineer, project engineer, division engineer, engineer maintenance of way, chief engineer and assistant director of railroad engineering for an engineering construction company. He has worked for the Katy, the Missouri Pacific, the Chicago and Eastern Illinois and the Rock Island railroads. For the last eight years Jim has worked for the Federal Railroad Administration as regional track engineer at Kansas City, Missouri. The subject Mr. Hunter will be talking about is of vital concern to all of us because he is going to tell us how we can get a little bit better warning on some of these big storms that several of us have had to pick up the mess after recently. Jim.

EARLY DETECTION OF STORMS

James T. Hunter

Regional Track Engineer
Federal Railroad Administration

Thank you, Steve. Members and guests. Since the weather is a topic we will cover today I want to tell you a little story about the National Weather Service. The National Weather Service issued a tornado watch from 1 to 4 pm for a town in central Missouri. And from 1 to 4 pm there was not a cloud in the sky. Consequently, a little old lady from the town called up the National Weather Service and complained that the Weather Service was all wet about its predictions and it didn't know what it was doing. The following day the National Weather Service again issued a tornado watch from 1 to 4 pm and again the watch expired without a tornado in sight. So the woman again complained to the National Weather Service saying that the skies were clear and there was no sign of a tornado in the area. The third day the National Weather Service again issued a tornado watch for the town from 1 to 4 pm and this time the town was devastated by a tornado. The little old lady crawled out of her basement, walked two miles to a telephone, called the National Weather Service and said ''Now, that's more like it.'' (Laughter)

Gone are the days when the railroad section foreman was responsible for a short segment of track and railroad officials depended upon him to patrol the track in the event of storms and heavy rainfall. Although he was not infallible, he did a pretty good job of inspecting the track when the heavy rains occurred at any time of the day, on weekends, and on holidays.

When the foreman was to be away from the section, he would make arrangements for an assistant foreman or the adjoining section foreman to cover an emergency or inspect the track in the event of heavy rainfall.

Need for Weather Information

Cycle track maintenance and programmed track renewal work by large mechanized gangs now enables the railroads to operate more efficiently with fewer employees. Track sections have either been extended many times or abolished. Floating truck gangs now perform track maintenance at the direction of the railroad's track inspector or roadmaster. The personalized protection once afforded the railroad by the section foreman in the event of heavy rainfall is gone.

In some instances, nothing has adequately replaced the weather watch of the section foreman despite the fact that technological improvements in recent years have made weather information much more accessible.

Environmental conditions are very important to the operation of a railroad. Heavy rainfall is dangerous in that ballast in the track is quite vulnerable to the action of water. When track ditches, drainage ditches, or streams cannot handle heavy rainfall, track washouts are likely to occur. All too frequently, trains run into a washout and derail at night when daytime station agents, train order operators, and maintenance personnel are asleep.

Accident investigation is part of my job with the Federal Railroad Administration. I first became concerned about the need for railroads to do a better job of monitoring the weather when on July 3, 1981, an engineer and front brakeman on the Colorado and Southern Railway drowned when their continuous welded rail train ran into a washed-out bridge at Frijole Creek, 16 miles to the east of Trinidad, Colorado. The rainfall that occurred in Southern Colorado on the evening of July 2, 1981, and the early morning hours of July 3, 1981, was widely scattered. The National Weather Service at Trinidad on July 2, 1981, recorded rainfall beginning at 9:55 p.m. and ending at 10:20 p.m. The July 2, 1981, total rainfall recorded at Trinidad measured only 0.15 inches. However, after 9:30 p.m. on July 2, 1981, torrential rains fell on the Frijole Creek Basin above the railroad bridge 16 miles to the southeast of Trinidad. Post accident investigation of National Weather Service radar overlays from the Limon, Colorado, station documented the heavy rainfall intensity levels at hourly intervals. No official rainfall recording station is located on the Frijole Creek drainage area, but unofficial reports estimate an average of 11 inches of rain fell on the drainage area above the bridge in a four-hour period. Our accident investigation verified that remoted real time color weather radar imagery could be used to monitor rainfall location and intensity, and from the information obtained, track inspection could have been initiated.

At Kansas City on June 14, 1982, I watched the local 10:00 p.m. television news when the weatherman advised of severe thunder storm warnings and flash flood watches issued by the National Weather Service for western Nebraska and eastern Iowa. A radar display of the intense rainfall occurring at the time in eastern Nebraska was shown on television. Later on in the night I was awakened by a telephone call informing me that an Amtrak train had derailed on the Burlington Northern Railroad in southwestern Iowa near the town of Emerson. Both locomotives and all 12 cars derailed when traveling at a speed of about 79 miles per hour. A young mother was killed and 24 people were injured in the accident. The monetary damage amounted to over three million dollars.

Investigation of three other train derailments caused by washed out track revealed that color weather radar imagery and National Weather Service information could have been used to initiate track inspections and possibly have prevented the accidents. The accidents included:

> The Amtrak train derailment that occurred on July 7, 1984, near Essex Junction, Vermont. In this accident five people were killed and 44 were injured. The accident on the Central Vermont Railroad caused over six million dollars in damage.
>
> Three locomotives and 41 cars derailed in a washout on the St. Louis Southwestern Railway when traveling at a speed of about 55 miles per hour at Durham, Kansas. The engineer and front brakeman were injured in the derailment that occurred on April 27, 1985.
>
> The Kansas City Southern Railway Company derailed 28 cars in a washout at Shoal Creek near Neosha, Missouri, on November 18, 1985. A high water detector only 0.4 of a mile from the washout was apparently functioning but was not activated by high water. A clear signal was displayed for the train. A review of National Weather Service radar overlays from the Monett, Missouri, station revealed almost 15 hours of continuous rainfall on the Shoal Creek watershed prior to the washout.

All five of these mentioned washout derailments occurred outside of normal working hours. Four of the five accidents occurred in darkness. The fifth accident occurred in the early morning hours after darkness. The rainfall that caused the washouts could have been monitored on color weather radar displays. In some instances, the National Weather Service had issued severe thunderstorm warnings and flash flood watches.

REPORTABLE RAILROAD TRAIN ACCIDENTS IN THE UNITED STATES OF AMERICA CAUSED BY WASHOUTS*

Year	Number	Killed	Injured	Damage
1982	21	4	43	$ 8,701,777
1983	7	0	5	1,265,938
1984	8	5	57	8,750,029
1985	7	1	5	3,141,935
Totals	43	10	110	$21,859,679

*Accidents reported to the Federal Railroad Administration.

Sources of Weather Information

A review of railroad accidents caused by washed out track leads me to believe that railroads can do a better job of monitoring the weather. When heavy rainfall occurs, the initiative must be taken to patrol the track in advance of train movements.

But how does your railroad monitor the weather? Having the train dispatcher check with train order operators every four hours about weather conditions and relying upon train crews to report weather conditions is by itself an insufficient weather gathering method. Additional weather data is necessary to make a judgmental decision on whether or not to require a track inspection.

There are many methods of obtaining storm, rainfall, and flooding information. Some of the methods are as follows:

- Weather forecasts from newspapers.
- Weather forecasts and current weather information from commercial radio and televisions stations.
- National Oceanic and Atmospheric Administration's (NDAA) Weather Radio. (24 hour information)
- NDAA's Weather Wire. (24 hour information)
- Cable television — The Weather Channel. (24 hour information)
- Network real time color weather radar available from weather forecast consultants.
- NDAA's weather satellite photos available through weather forecast consultants.
- Flood indicators.
- Weather station and private citizen reports of rainfall measurements
- Employee weather reports
- Private citizen weather reports

Weather information is important to railroad operation and should be acquired from all available sources. Real time color weather radar data is extremely useful because it provides information on rainfall as it occurs. An intense rainfall or moderate rainfall combined with a stalled frontal system are both potentially dangerous to the track. Weather radar imagery can be obtained from a telephone line and displayed on a monitor (cathode ray tube) for depiction of rainfall locations and intensities. Several weather forecast consultants provide single source weather systems that enable railroads to ''dial up'' and view radar displays of 58 National Weather Service (NWS) network radars across the country on a 24 hour basis and 70 other NWS radars that operate when needed, on a part-time basis. A radar remoting receiver and monitoring system and long distance telephone service is essentially all that is needed. The availability of remoted radar weather data provides the railroad with the opportunity to monitor rainfall and have the track inspected in advance of train movements. Color weather radar data identifies six levels of rainfall intensity.

VIP Level	Color	Echo Intensity	Estimated Precipitation	Rainfall Rate Stratiform	Inches/hour Convective
1	Lt Green	Weak	Light	Less than 0.1	Less than 0.2
2	Dk Green	Moderate	Moderate	0.1 - 0.5	0.2 - 1.1
3	Lt Yellow	Strong	Heavy	0.5 - 1.0	1.1 - 2.2
4	Dk Yellow	Very Strong	Very Heavy	*	2.2 - 4.5
5	Lt Red	Intense	Intense	*	4.5 - 7.1
6	Dk Red	Extreme	Extreme	*	More than 7.1

*Very heavy, intense, and extreme stratiform rain does not occur.

Access to National Weather Service radars can be arranged through either commercial radar remoting transmitters or through the Government's Radar Remote Weather Display System (RRWDS). The particular transmitter utilized determines the range displays available. Several transmitters use the 100 and 200 nautical mile range (NMI). At least one commercial system displays 60, 120, 180 and 240 NMI ranges.

It is not necessary to continuously monitor the remoted weather radar displays. However, a system is needed to alert the user and initiate the monitoring of moderate and heavy amounts of rainfall. Probably the best method of alert is with the use of a weather forecast consultant who employs technical personnel and certified meteorologists on a 24 hour basis. Because these consultants supply weather data to many different companies, the service is cost effective. Such diverse organizations as railroads, airlines, truck lines, utilities, and state, county and city governments use weather forecast consultants. These companies can provide you with weather information that is pertinent to your particular area and situation. The unwanted information is filtered out. The weather forecast consultant has the capability of providing the following:

- Radar remoting
- Weather alerts
- National radar summaries
- Satellite photos with weather interpretation by telephone
- Weather maps showing frontal systems, rainfall forecasts, expected temperatures, etc.

Another method of alert to initiate weather radar monitoring is with the use of National Oceanic and Atmospheric Administration's (NOAA's) Weather Radio. NOAA Weather Radio is the voice of the National Weather Service. A total of about 358 weather radio stations are located across the continental United States. Most of these stations operate 24 hours a day and provide continuous broadcasts of the latest weather information. Taped weather messages are repeated every four to six minutes and are routinely revised every one to three hours, or more frequently, if needed. NOAA Weather Radio broadcasts can usually be heard as far as 40 miles from the antenna site and the broadcasted message is tailored to the weather information needs of people within the receiving area. For example, lake level elevations are routinely furnished. When area rivers are at flood stage, three-day river stage forecasts are issued and listeners are advised of expected river cresting. This specialized information is provided in addition to general weather information. The seven weather radio frequencies are not found on the standard AM-FM radio but there are now radios on the market that offer the standard AM-FM frequencies plus the so-called "weather band" as an added feature. A number of radio manufacturers offer special weather radios at reasonable prices. The cost of a weather radio is comparable with the price of a standard AM-FM radio.

During severe weather, National Weather Service forecasters can interrupt the routine NOAA Weather Radio broadcasts and substitute special warning messages. The forecasters can also activate specially designed warning receivers for a weather warning or watch (demonstration). This particular 110 volt alternating current radio is provided with a nine volt direct current battery backup in case of a power failure. The warning tone is activated as an alert for the following situations.

National Weather Radio Alarms

The warning tone will be used for the following watches and warnings on initial issuance and subsequently as appropriate:

	Watch	Warning
Tornado	Yes	Yes
Severe thunderstorm	Yes	Yes
Flash flood	Yes	Yes
Hurricane	Yes	Yes
Tsunami	No	Yes
Marine	N/A	Yes
Winter storm	No	Yes
Blizzard/severe blizzard	N/A	Yes
High wind	N/A	Yes
Dust storm/sandstorm	N/A	Yes
Flood	N/A	Yes
Enemy attack	N/A	Yes

A **watch** is issued when a weather event is probable.

A **warning** is issued when severe weather or an emergency is reported or imminent.

Many NDAA weather radios would have to be used by a railroad over the entire railroad route to provide an adequate alert to initiate the monitoring of radar weather. Keep in mind that the warning tone is activated for conditions affecting listeners in the receiving area.

Officials on several railroads were contacted and asked about the methods their railroads use to obtain rainfall and weather information. Some of the railroads contacted still rely solely upon the dispatcher to obtain weather information from agents, operators and employees on duty. One railroad has a weather forecast consultant available to furnish 12 hour forecasts twice daily but does not routinely furnish the information to train dispatchers or track maintenance supervisors. Not all railroads were contacted, but two of the railroads contacted have in place alert warning systems of significance that you should know about. The Burlington Northern Railroad Company uses 111 weather alert warning radios along BN railroad routes within range of NDAA Weather Radio stations. All but one are located at points where operating personnel are on duty 24 hours a day.

Operating instructions require BN personnel to operate the weather alert scanner or radio in a mode to receive the emergency broadcast warning tone. This is done except for the time the radio is in use to monitor NDAA Weather Radio reports for threatening local weather conditions. After receiving the alert warning tone, individuals are instructed to listen to the NDAA weather watch or warning and report the tornado, flash flood, or severe thunderstorm message immediately to the train dispatcher for handling.

BN's Springfield, Missouri, regional dispatcher's office is equipped with cable television. When one of the dispatchers receives a weather watch or warning message, the chief dispatcher at Springfield monitors the Weather Channel for conditions adversely affecting railroad operations. The Weather Channel operates 24 hours a day from Atlanta, Georgia, providing national weather information to subscribers. Emphasis is placed on timely weather warnings and storm or flood watches. The Weather Channel frequently provides viewers with real time color weather radar displays showing rainfall rates. BN's use of the Weather Channel and NDAA's Weather Radio provide an economical package for evaluating weather conditions. The Springfield Region, however, is the only region on the BN that uses the Weather Channel.

Some time ago, the Chicago and North Western Transportation Company experienced a 20 foot washout on the main track of its suburban branch line railroad near McHenry, Illinois. A severe local storm, with intense rainfall dropped six to eight inches of rain on McHenry to cause the washout. Track maintenance forces were headquartered about eight miles away at Crystal Lake, Illinois, but only one half inch of rainfall was recorded at that point. A suburban train went over the washout without derailing, but this incident was cause for alarm. It provided CNW with the incentive to seek out methods of obtaining weather information on a timely basis. Subsequently, CNW has, in 1986, installed an IBM Professional Computer in the railroad's operation control center at Chicago, Illinois, that has the capability of accessing color weather radar data from thirteen National Weather Service radar sites in the territory in which the railroad operates. The railroad route is shown as part of the background map displayed for each of the thirteen radar sites and permits accurate location of rainfall with respect to the railroad. Telephone speed dialing accelerates the "dial up" of the weather radar display. Radar images can be stored and recalled to observe the rainfall intensity trend, and the direction and speed of rainfall movement. A hard copy teleprinter also permits the printing of radar displays in black and white. A weather forecast consultant is providing a weather alert to CNW when rainfall is either forecast or observed in amounts of one inch or more or winds of 40 miles per hour or stronger are expected.

CNW is establishing a data base by logging actual rainfall accumulation for comparison with the remoted radar intensity levels as shown on the monitor display.

Real time remoted color weather radar data provides an opportunity for early detection of intense or prolonged rainfall. The information obtained, however, will only be helpful if used to initiate track inspection in advance of train movements. It is good to know that several railroads are using National Weather Service information to advantage. The opportunity is here to add color weather radar to your system of gathering weather information. Let's make the most of it. Let's keep the train on the track and improve railroad safety. Thank you.

Mr. Lewis: Thank you, Mr. Hunter. Our next speaker will be Mr. Steve LaRocco with the Long Island Rail Road. Mr. LaRocco will be discussing the construction of the John D. Caemmerer West Side Storage Yard in Manhattan, New York. Mr. LaRocco received his Bachelor of Science degree from Rensselear Polytechnical Institute and his Masters in Business Administration from the New York Institute of Technology. Mr. LaRocco has been with the Long Island for fourteen years beginning as a junior engineer of track in 1971. He continued to work within the maintenance of way department obtaining the position of engineer of production. He then moved to the capital construction group where he is now a senior project manager responsible for some $300 million of construction work. Mr. LaRocco.

WEST SIDE YARD CONSTRUCTION

S. A. LaRocco

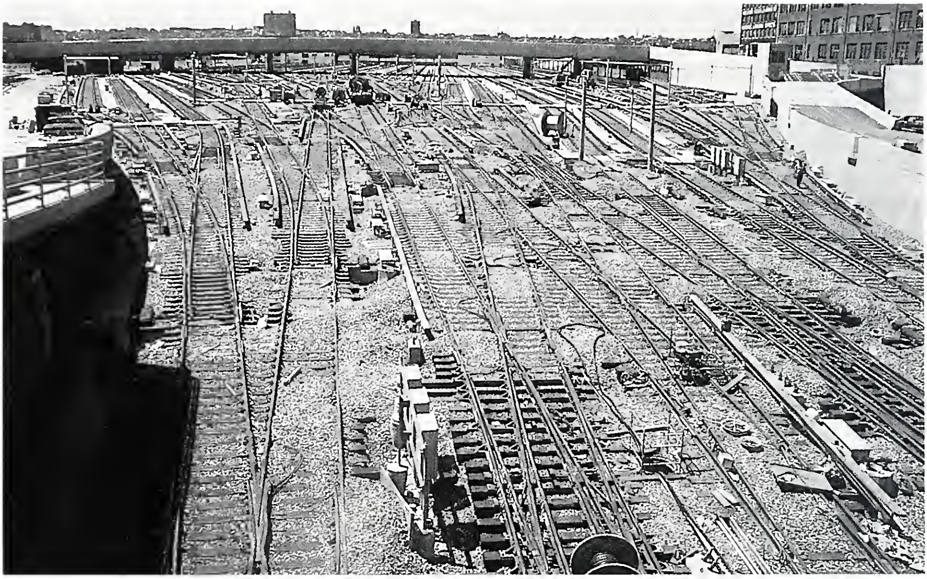
Senior Project Manager
Long Island Rail Road

Mr. LaRocco: Thank you and good morning. I would like to thank the B&B and Roadmasters' Associations for inviting me here this morning and allowing me to present what we, on the Long Island Rail Road, think is a very critical project.

Project Description

The Long Island Rail Road is currently in the midst of a major capitol program to update service reliability as well as rehabilitate its plant. The major element to this program is the construction of the J. D. Caemmerer West Side Storage Yard. Construction of the West Side Storage Yard will improve the Long Island Rail Road's dependability and on-time performance. Trains traveling into Penn Station will continue west into the yard reducing station dwell time and increasing Long Island Rail Road to Penn Station tunnel and station track capacity approximately 25 percent. Currently, morning rush hour trains move west through the tunnels to unload passengers at Penn Station. These same trains will then run empty eastbound through the tunnels to eastern terminal storage locations thereby reducing peak direction capacity.

Evening trains will originate in the new yard, pick up passengers at Penn Station, then continue eastbound. The new storage facility will reduce tunnel congestion and conflicting movements since one eastbound river tunnel will no longer be utilized to capacity with non-revenue trains. The result will be added capacity, increased reliability and on-time performance.



The new yard throat, shown in construction, features conventional timber turnout construction. This looks west from the portal where the tracks emerge from Penn Station's underground track network.

J.D. Caemmerer Yard

This first slide is an aerial view of New York City. The J. D. Caemmerer Yard is located in the midst of Manhattan with a beautiful view of the Hudson River. You can see the yard in the middle of the screen up to the left. The yard is a 20 acre rectangular-shaped tract of land that is situated two blocks to the west of Penn Station, bounded on the east by Tenth Avenue, on the west by 12th Avenue, on the north and south by West 33rd and West 31st streets. The yard has been under construction since 1982 and is dedicated in the memory of the late State Senator John D. Caemmerer. He headed up the New York State Transportation Committee and was a major influence in the Long Island Rail Road receiving its capital funding. The yard is expected to be completed during the spring of 1987 and will be capable of holding 320 M1 or M3 electric cars, the equivalent of five miles of cars on its 30 tracks. Once the Caemmerer Yard and improvements to Penn Station are completed, it will enable the Long Island Rail Road to increase train capacity by some 25 percent. The yard is being built as part of the MTA/Long Island Rail Road five year capital improvement program at a cost of approximately $185 million.

As you can see in this slide, the yard is bisected by the elevated 11th Avenue viaduct. The 11th Avenue viaduct was entirely rebuilt under this project. Its piers were relocated to open more space for additional tracks, just to the east of 11th Avenue. In anticipation of future development of air rights, footings and piers for a proposed New York City Transit Authority bus garage were provided and installed.

Tunnels

The development of air rights over this portion of the yard is made possible through adequately spaced tracks which permit the construction of footings now and the erection of columns at a later date. Running east and west through the existing yard under the Hudson River are two existing Amtrak tunnels, shared by Amtrak and New Jersey Transit which carry passengers to and from Penn Station to New Jersey and points north and south. This existing tunnel is constructed entirely of brick and extreme caution had to be taken by all contractors during construction and blasting phases of the project to ensure the structural integrity of the tunnel. During the rock blasting portion of construction extreme caution had to be used in coordinating the blasts with Amtrak train traffic in the tunnel thus avoiding major disruption to train service.

Another major construction effort in the yard was the construction of the north access tunnel presently terminating at 33rd Street just west of 11th Avenue and at the west side of 10th Avenue. This is a single track concrete box structure passing over the existing Amtrak north river tunnels and underneath the existing yard tracks. Amtrak plans to extend the eastern end of the north access tunnel under 10th Avenue. The extension of this construction north of 33rd Street along the existing Long Island Rail Road right-of-way began this past August.

Also constructed for Amtrak's use was an emergency evacuation tunnel connecting the existing Amtrak north river tunnel with the 33rd Street evacuation shaft. The former shaft was located on 32nd Street which was demolished under this contract and is now replaced by the evacuation shaft at 33rd Street. Thirty-second street now remains as a paper street on the city records.

B Yard

To the east of Tenth Avenue and also part of the West Side Storage Yard construction we have the existing Long Island Rail Road B Yard, which is a four track storage yard. This is located just west of Penn Station. B Yard will become the main link between Penn Station and West Side Yard. The B Yard is located on the right hand side of this photograph.

This is an aerial view of the yard looking west over Ninth Avenue with the 16 story Lerner Building in the background. Presently the Long Island Rail Road can store 38 cars on these four tracks. The four tracks were originally 12 feet lower than the general elevation of the Caemmerer Yard. The original yard was removed and totally reconstructed in order for the Long Island Rail Road trains to eventually feed into and out of the yard. The four B Yard lead tracks are sloped upward on a three percent grade from Penn Station to the yard.

This is a view of B Yard looking east with Ninth Avenue immediately in the front. Behind that is the post office and then right behind the post office is Penn Station and Madison Square Garden. The four new lead tracks of the yard are shown on the extreme left. You can tell by the different color of the ballast.

The yard storage tracks are built on concrete slabs.

Standing directly underneath the Lerner Building, we are looking east right into B Yard. Notice the three percent grade sloping away from us. Crash walls were erected on the left and right sides, protecting the Lerner Building columns. The double slip shown on the right hand side just down past the column line, will eventually lead into what is called the Five X Connection. This track will give the Long Island Rail Road train access to the Five X ladder leading to platform tracks 14 and 15. This connection will be used for emergencies only.

This slide is B Yard looking west on the Lerner Building. The four lead tracks from B Yard fan out into the 30 storage tracks in the yard. The building on the right is our tower substation building.

Looking east under Tenth Avenue and the Lerner Building we see the yard throat area converging on the B Yard lead track area. If you look closely you can see the lights of trains that are currently being stored in this yard today. This photograph was taken in approximately September 1985. The yard looks much different today.

In order to connect the Caemmerer Yard with B Yard trackage, approximately 5,000 cubic yards of solid rock had to be blasted from underneath Tenth Avenue to create a tunnel that would join both yards. While this work was going on, Tenth Avenue had to be supported as did the 16 story Lerner Building that straddles a portion of B Yard on the east side of Tenth Avenue. The Lerner Building had to be elevated one-quarter inch by jacking the building with hydraulic jacks so we could insert a 70 foot long 45 foot ton steel needle beam that now supports the entire Lerner Building structure over the B Yard span.

This is a picture of the ballasted track area where the 30 yard tracks converge to the four lead tracks in the B Yard. The construction is 119 pound rail on wood ties and the stone ballast is subgrade. You can also see that third rail traction power is used here. Now this picture was taken last week so this is what the yard does look like now.

Equipment Maintenance Shop

Moving to the southeast corner of the yard we have Tenth Avenue south access road bridge and the maintenance of equipment repair shop building. This picture was taken in late 1985. The south access road bridge is the main pedestrian and vehicle entrance into the yard. Police will be posted at Tenth Avenue, which is to the top of the picture, and a guard house 24 hours a day. The building in the background is the tower substation building, which is a current picture, and you can see the walkway across the yard with the colored glassway.

Here we have a view looking east at the maintenance of equipment shop. Immediately in front of us we see a 12 inch thick concrete subslab, upon which ballast and standard wood tie construction are placed. The subslab distributes the load over a larger area thus reducing overall yard maintenance.

This shows the completed shop lead tracks to the building. The contractor is currently in the process of installing the fixation shop tracks. The two large overhead doors are for track access and the center door will be utilized by high/lows, small trucks or pedestrian traffic.

This is a picture inside the shop. This is the service pit track. This track will be utilized for the undercarriage repairs and inspections. The track fastening bolts can be seen grouted in place. The welded sections of the shop rail can be seen off to the right. A 15 ton overhead crane can be seen in the background and the tracks running along on top left side. This is another picture of the shop. The track on the right hand side is the wheel truing track. The shop tracks are designed for two pair of electric cars on each track.

This is a view of the wheel truing pit. The wheel true will trim flat spots from the wheels of the M1 and M3 cars without wheel removal from the car body. You can see the shop rails sitting on top. That still needs to be cut in place there.

This is a shot of one of the turntables inside the shop.

This is a close-up of the 15 ton crane. Notice how the building curves around to the the left. You can see it in this slide here. There is a monorail crane that runs up along the back and then heads back into the storage areas. These are two five-ton hoists, and they are connected, which run the length of the shop out and around and into the storage areas and the loading docks.

Here is a view of the main car service area of the shop. Drilled and grouted into the concrete slab are anchor bolts which support the knee high steel columns to which the rail will be fastened. Cars will be brought into the shop and can be comfortably worked on at eye level. All under-car repair can be handled efficiently and effectively from these four repair areas. The steel structure that you see on the left is the elevated platform which will provide the access to the outside and interior of the cars at floor level. When these platforms are being used, removable railing sections which you can see in place are removed from the sockets in the concrete platform. When not in use the railings provide for a safe walkway area. When finished, the maintenance of equipment shop will house a six-track indoor repair shop. The shop will be capable of performing light duty repairs and 30 and 90 day periodic inspections.

Emergency Facilities Building

The next building to the west and south is the emergency facilities building. This picture was taken at the start of the foundations and formwork for the walls of the building. The vertical 20 inch fiberglass pipe that you see is a water supply pipe with a 75,000 gallon water storage tank that will provide water for the yard's fire fighting system. This is a picture of that completed building.

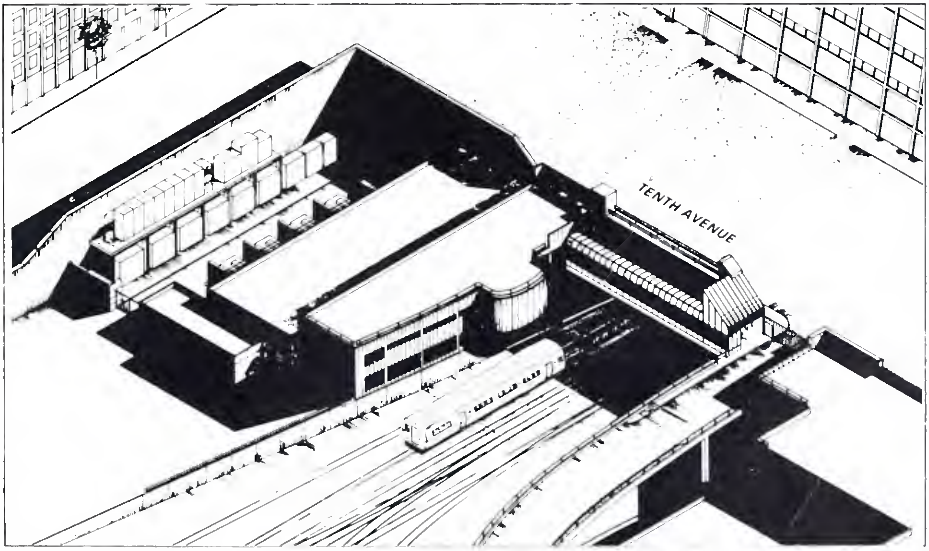
Emergency facilities building will store the yard's toilets and servicing vehicles used by the maintenance of equipment personnel. It will house the emergency generators needed in case of power failure by our utility company, Con Edison.

Administration Building

As we move further west along the site in a clockwise direction we come to the TA Building. On the right hand side of the picture you can see the Transportation Administration Building during construction. The building will house our police personnel and management for the transportation department. Train crews will have lounges and locker rooms and there will be a ticket receiver's office. A radio electronics repair shop will also be housed here. This shot of the transportation building shows concrete blockwork installation. Notice the bumping blocks. These hydraulic units will mitigate train or track damage during slow impact collisions as well as prevent our trains from entering 12th Avenue.

Fleet Building

This is a shot of the fleet building. Today it is currently about 95 percent complete. Notice the hydraulic bumping blocks protecting the building. These are to prevent our crews from making any new entrances.



Aerial view of the John D. Caemmerer Storage Yard lead tracks connecting Penn Station with yard.

At the extreme west end of the site, paralleling 12th Avenue, running north and south we have the west end access road which you can see here. This road exits on both 12th Avenue and 33rd Street. The 12th Avenue exit will be used as a delivery and receiving point for car cleaning supplies to the interior car cleaning building. The 33rd Street exit will be used for emergency and fire vehicles only. To your left you can see a corner of the yard operations building being erected. Overhead is the old Conrail high line. A section of the viaduct had to be raised during this project so that trucks could access the service road.

This is a shot of the 33rd Street exit or entrance.

This picture is of the yard's operation building. This building will support the maintenance of equipment shop building on sequencing trains for maintenance and repair into the repair shop building as well as scheduling and managing car cleaning and toilet pumping activities.

Interior Car Cleaning

This shows a view of the extraordinary interior car cleaning platform looking west. You can also see in the background the yard operations building on the left and the EIC storage building on the right. The EIC storage building will be used to store all interior car cleaning equipment required for the cleaning of train interiors. The EIC platform is a narrow platform just wide enough to provide for the maintenance of car interiors. This platform will allow servicing the interiors of two 12 car trains at any one time. On the right side you can see the perimeter wall along 33rd Street.

This is looking west along the EIC platform. Trains will be moved in and out of these platforms all day long. The platform is designed for each access for maintenance crews to perform their daily car cleaning responsibilities. Notice the ramp on the east end of the platform. This ramp leads to a system of cartways which service tracks throughout the yard. The cartways and walkways shown here are precast concrete sections installed in place throughout the ballasted track sections.

As we move further east we see the yard converging toward the throat area. Off to the extreme left we can see a service access. You can also notice the maintenance of way storage doors located under the northeast access road. There are three storage areas accessed only by exterior overhead doors and these will be used as yard storage areas.

This bridge is used to gain vehicle or pedestrian access into the substation and track areas on the north side of the yard. It runs down on 33rd Street to the substation area, around and onto the track level.

You are looking east toward Tenth Avenue in the fall of 1985, with the Lerner Building in the background. This is the yard throat area where all 30 tracks converge down onto the four lead tracks that go underneath Tenth Avenue, through B Yard and into Penn Station. The area you are looking at now was virtually solid rock two years ago, calling for the removal of over 11,000 cubic yards of rock. Rock removal in this area was done both by blasting and by mechanical means. As we got closer to the Amtrak tunnel, which is immediately to your right, underneath the south access road bridge, we had to go back to manual or mechanical means of rock excavation in lieu of blasting to avoid damage to the tunnel. To your left you can see the tower substation building which is accessed by a pedestrian walkway going across the through area. This is the same area today. Ninety-five percent of the track work is completed.

AC Switch Gear Substation

Here is a construction shot of the tower building. The tower portion of this building houses our signal equipment rooms, our drill crews, our substation maintenance people and the tower control room which will remotely perform all the signal and switching operations in the yard. The yard signal system uses a microprocessor base control unit that monitors and controls the movement of the trains, switches, and signals into and out of the west side yard. Our AC and DC power substation equipment is also housed here.

Here we see one of the seven 4,000 kilowatt transformers in its concrete pad that transforms incoming Con Ed AC 13,000 voltage down to 700 volt DC. On each side of the transformer pads you can see the concrete fire walls used for protection in case a transformer explodes.

This area is the AC switch gear substation. On the left hand side of the ten AC switch gears Con Ed will energize their feeders at this location. The safety power 13,000 volts will be transformed to the 700 volt DC power to feed the yard. Con Ed is currently in the process of energizing two feeders. Full yard energization is expected in mid-October.

This is a view of the interior of the DC substation building under construction. This portion of the building is used to house DC rectifiers and the DC switch gear which contain the breakers for all the yard DC feeder services. All the DC equipment installed in this room is electrically isolated from concrete by the application of an epoxy coating to the walls and floors. All equipment is completely isolated from the ground. Even the anchor bolts are isolated in an epoxy ground. This shows one of the DC switch gears. The room is substantially complete.

Below the DC switch gear room we have the basement of the substation that contains a negative electrical return which connects to the rectifiers above and the positive electrical cables which come down from the switch gear. The concrete encased ducts shown here form the conduit for all the cable pulling operations in the substation building. From this building the cables are fed through a maze of underground conduit out into the yard. Over 13 miles of 2,000 MCM cable will be used in this yard for DC traction power.

All the cables originating from the DC substation building will terminate in the yard as shown here at duct turn ups. These cables from the substation are either terminated at the third rail or terminated in the third rail disconnect switch which is used to isolate third rail sections from other portions of the yard for maintenance and emergency use. On the roof above the DC rectifier room we have the automatic smoke bin which opens in case of interior fire or excessive heat buildup. These vents will rid the substation of all smoke and also maintain ventilation inside the DC rectifier building on unusually warm or hot days.

Tower Substation

The heart of the signal system is also housed in the tower substation building. Here is a typical entrance relay rack which receives all the track circuit information from the yard track and wayside equipment. This information is fed from the field through these relays to the microprocessor control unit. The microprocessor will then send the information back out to the field to control yard movements. All yard relay logic is non-vital except where movements interface with Penn Station access. Here is a typical dwarf signal that will be located throughout the yard. These will be used to control yard movement.

This is a picture of the new control room. This is where the microprocessor will be housed. Notice the small window. There is no anticipated visual monitoring of the yard operations. The yard will be run strictly through the microprocessor control panels. The master yard display panel will be located to the left side of the picture.

This shows a little more clearly the room's aesthetics. The walls have beautiful oak stripes, the floors are all covered with rugs; it will just be a nice place to work. The windowed room to the back will house the tower supervisor's office. The room is designed to be environmentally suitable for the microprocessor.

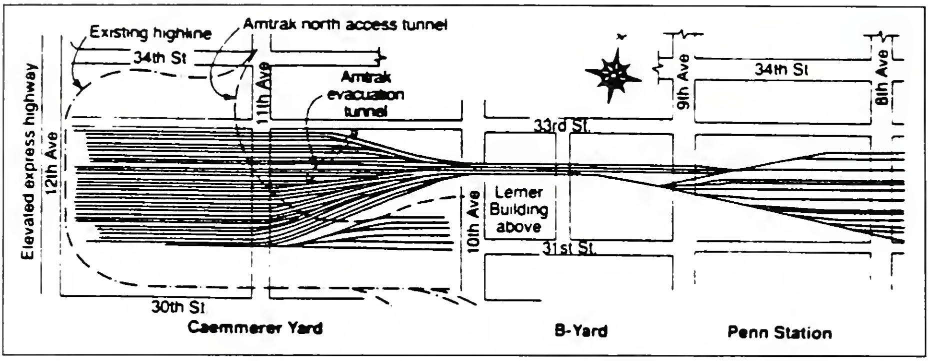
This is a picture of one of our transportation supervisors factory-testing the microprocessor in England. Westinghouse Brake and Signals is the manufacturer of the control equipment. The equipment arrived from England last week and installation should be starting this morning. The equipment displays track occupancy, signal indication, switch indication, as well as train identification.

The right hand side of the board displays the 30 yard tracks converging into the four B Yard lead tracks. The board will display the yard exactly as it appears if one was to look out into the yard.

Amtrak Interlocking

This area shown is the track layout for Amtrak's A interlocking into the Penn Station platform areas. Track circuit indication will let the tower operator know the track occupancy status in Penn Station. A minute board will be installed in A tower showing what movements are occurring in the yard. The board will also let the operator at A tower know what trains are on the B Yard leads and to what station track they should be aligned to.

This shot was taken from the top of the 16 story Lerner Building that is just east of the Tenth Avenue spanning over B Yard storage yard. A continuously reinforced concrete track slab with controlled tracking was chosen for the western portion of the Caemmerer Yard. This



Long Island Railroad's new storage yard runs west of the line's Manhattan train terminal.

type of construction was chosen to reduce the track maintenance. On the east side of 11th Avenue, conventional track ballast over a concrete subslab was used. Porous material was evacuated from the site. Suitable subsurface material was delivered and compacted. A layer of asphalt was laid on the compacted fill upon which the concrete track slab was laid. This subbase was used to minimize any track settlement. The slab track was used on the tangent portions of the yard only. We have used similar construction on our mainline track and found it to be highly successful.

Slab Track

A restrained subslab provides a transition point for loads from the continuous slabs of the conventional sections of track as can be seen here in this slide. A running rail will be fastened to the continuously reinforced concrete slab and held in place by Pandrol rail clips and elastic bearing pads attached to the concrete slab.

The inserts that hold down the rail are drilled into the concrete slab and are held in place by a polyester grout. The fasteners are dipped into epoxy for further electrical isolation prior to insertion into the polyester grout in the concrete slab. Once the anchors are set in place, a black polyethylene one-eighth inch thick pad is placed over the inserts down onto the concrete to provide further electrical isolation. On top of the polyethylene insulating pad is a thick rubbery elastomeric bearing pad. On top of this elastomeric bearing pad we place the actual Landis Fastener System that is bolted down to the concrete.

The rail is held in place by the clip angles and the Pandrol spring type rail clips shown here. The alignment of the rail is achieved by the means of eccentric cam that is located below the nut that you see in this picture, which is torqued down to the final torque of 25 foot pounds holding the rail securely in place. The Pandrol fastener was manually put in place and driven home by a machine.

This slide shows a man cutting off the mill end of the rail in preparation for thermite welding to insure continuously welded rail throughout the yard. The yard rail had all been welded on site. The contractor had constructed a welding plant here to expedite his construction and to mitigate his cause. Also provided in the yard is an extensive network of underground sewer and water lines to service the railroad's airline type toilets on the passenger car fleet.

Shown in this slide are the five foot wide carways that are adjacent to each track to provide access to the service consoles for the toilet servicing vehicles that service each car.

Here we can see construction work is placed in colored concrete into the carways between the continuously reinforced concrete slabs. Concrete in each carway colored red signifies that only authorized persons are allowed to be within this area and that safety is to be exercised at all times while using these carways.

Throat Area

Here we see the installation in the throat area of one of the 80 turnouts that are going to be installed throughout the yard. This particular slide is of a double slip.

The throat area is a highly congested area, as you can see and fans out to the 30 storage tracks just west of 11th Avenue. The standard track tie ballast system over concrete subgrade was chosen in this area due to the difficulty in installing these turnouts by direct fixation.

Here is another view of the throat area just looking east towards the south access road and the maintenance of equipment building there in the background. At the bottom of the picture you can see some of the single conduit terminations that were installed in the yard prior to the track installations.

These cantilevered posts are for our motormen to do their cab signal testing. They are placed in every one of the tracks.

The next two slides show the yard as it appeared in the winter of 1983 to 1984. Since this time we have made tremendous progress. The yard is scheduled to open in May, 1987. The construction budget is $185 million. When in service the yard should help the Long Island Rail Road to increase its capacity into Penn Station thereby increasing train service reliability. The project also offers a yard that is virtually maintenance free.

At this time I would like to thank you for your time. Are there any questions?

Member: I noticed on the design of your signal building you used a rather old-fashioned type design for a signal tower with a cantilevered structure and bay windows, but there are no windows. What was the purpose for the signal tower to be cantilevered and bay-windowed that is not going to be for sight?

Mr. LaRocco: Well, it is cantilevered in that way because the display panel comes out over there. The room is cantilevered out and the master display panel will be sitting out over the cantilevered section.

Member: Could it have been anywhere else at all?

Mr. LaRocco: The way we are operating, sure, it could have been anywhere. No particular reason. It's just the way the designer designed it.

President Moorman: Thank you. I'd also like to thank John Kapp and Steve Hill for arranging everything this morning. Before we break up for lunch, I would like to mention, and most of you are probably sitting on them, that we again have put some blue cards on your chairs and I wish you would take a look at them and see what we are planning on doing next year and hopefully, sign up to do something. We are a strictly volunteer organization and we need all the help we can get. I would like to say one other thing about these, if you don't have any inclination to do any committee work, that's fine too, but everybody out here has got some problems and if you don't do anything else, you don't have to sign your name or anything, just take a pen and scratch on here maybe a couple of your worst problems. Don't tell us about financial problems or sexual problems or anything like that or if you do, be sure to give lots of details. But everyone has problems at work and one reason that we are here is to try and address problems and hopefully provide some solutions. I would like to encourage everyone to do that. I'll be making an address at 1:15 until about 1:30 so you can figure on about 15 minutes to kill in there and maybe you can come up with something. We're now at the end of the first joint session. After lunch, the Roadmasters will resume at 1:15 in the Red Lacquer Room. The B&B will start at 1:30 in the Adams Room on the Sixth Floor. I hereby declare this joint session adjourned. Thank you.

MONDAY AFTERNOON

September 15, 1986

President Bessey: Will everyone please be seated and will someone advise those in the foyer that the Bridge and Building session is going to begin.

Good afternoon. I hereby bring the 91st Annual Conference of the American Railway Bridge and Building Association to order. On behalf of the Association officers and myself, we extend a warm welcome to all members and guests. A few things have happened this morning already. John Kapp, who is our Senior Vice President, was called away right after he was introduced. He had a coal system that caught fire. Some deaths were involved so he had to take a plane back East and he hopes to be back later. We are sad that John Smith, a board member, was informed shortly after he was introduced this morning that his mother had passed away. The Association extends its sympathy to the Smith family.

Maybe it was easier 25 years ago to say "Let's get involved in your railroad organizations." We used to travel by passenger train; today there are fewer trains. Over the years there were downturns in business, so there are fewer dollars. With the consolidations taking place over the years, there are fewer people and with the continuation of consolidations and mergers, there are fewer railroads. So where do we go from here?

Well, as I see the activities in the railroad industry, we are still building bridges, we are still repairing bridges, we are still building track, and we are still maintaining track. We are still building buildings or remodeling buildings; environmental control activities are increasing. We're still installing drain lines; we are still building or maintaining fueling and sanding facilities and we are still installing new equipment and facilities of all descriptions.

So the work is still there to be done and the need to share knowledge and techniques on how to do that work still exists as it did 25 years ago, or even 50 years ago.

The information shared and the knowledge gained at conferences such as this still fulfills a need. This form of communication between the engineering and construction people of the railroad industry is the best form of communication I know of today. So getting involved in the railroad organizations keeps this form of communication open. And, of course, the organization of primary importance to us here this afternoon is the American Railway Bridge and Building Association.

Your board will, as they have in the past, come up with many interesting and informative special features for the conference in Kansas City next September, but it's the special subjects that require input from you and your fellow railroaders. Look at the subjects for next year on the blue card:

(1) Open Trench Shoring

(2) Quick Replacements of Bridge Spans Under Traffic

(3) Critical Problem Areas in Steel Bridges

(4) New Railroad Buildings

If all 750 members of the B&B, or at least the approximately 475 active members, filled out this card, furnished information and/or furnished slides, then I could say that the membership of this Association really got involved. If you don't fill out the card — well — you be the judge.

I have participated in the activities of the B&B and AREA for 35 years, and during that time I have contributed. However, I have received more from that participation in the associations than I have given. I know that my company benefited, just as all railroad companies benefit when their people are active in the railroad associations. Maybe they, too, get back more than they put in. Maybe its a little bit difficult to describe or explain to the powers that be, but I certainly feel that this is a fact that as we become involved in these associations, meet other people and get to know other people's problems and how they solve them, then our company benefits. So get involved and stay involved.

Now I would like to turn the program over to John Horney, the sponsor of our first special subject. John.

Mr. Horney: President Bessey, thank you very much. I would like at this time to introduce Mr. Steve Kenyon, who is going to give our next presentation which I think is of interest to all of us. I think the B&B Association here in the last three years and in the years coming up, as Don pointed out, has very interesting topics. I think we're getting right to the drift of the subject that some railroad people are kind of nervous to even talk about, which might be this next subject with our Fall Protection and Safety Climbing Devices. Mr. Kenyon is a graduate of Nebraska Wesleyan University and has a master's degree in industrial safety from the Central Missouri State University. He began his railroad career in 1974 with the Union Pacific Signal Department. From 1976 through 1979 he was manager of safety on UP's Wyoming Division. Since that time he's been assistant director of safety engineering. He is a member of the American Society of Safety Engineers, the National Safety Council, the AREA, this Association and is the chairman of the Safety Sub Committee of the AREA, Committee 27. He is also an all-around good guy. I believe that Steve is certainly qualified to talk on this next subject. I give you Mr. Kenyon.

Mr. Kenyon: Thank you, John. The program says that I am with the SP. That is not true. With the mergers and rumors of mergers and buyouts and everything, I called the office this morning to see if that was true and it is not. I'm with the Union Pacific Railroad. (Laughter)

SPECIAL SUBJECT NO. 1

Fall and Climbing Protection

Chairman: R. S. Kenyon, Asst Dir of Sfty-Engrg, UP, Omaha NE

Committee: T. J. Lager, B&B Supv, C&NW, Boone IA
W. N. Gilbert, Asst Chf Engr, TRRA of St Louis, Granite City IL

Injuries due to falls have plagued man since the first B&B man began leaving the ground. Early fall protection ran the gamut from nonexistent to haphazard and unreliable. Today, technological advances in fall protection have provided a full range of fall and climbing protection that allows workers to work safely with minimal interference from the protective devices. Still, for a variety of reasons, we see modern B&B workers imitating their ancestors in their disregard of adequate fall protection. Each year hundreds of American workers are seriously injured and dozens are killed in industrial-related falls primarily because fall protection equipment is one of the least used of all types of safety equipment.

USDLS Study

In June of 1984 the U.S. Department of Labor Statistics published a survey on falls from elevations. The survey was of 774 workers who had been injured in work site falls. More than 80 percent of these workers said that there was no fall protection in the area at the time of their accident. Most of the workers in this survey who had fall protection had either disconnected personal fall protection devices to move around or they were not in the immediate area where guard rails or similar protection was in place.

Some other significant points from this survey show that:

- 40 percent of the workers fell 10 feet or more
- 10 percent fell 20 feet or more
- 80 percent lost time away from work
- 30 per cent were hospitalized

Additionally,

- 45 percent reported that fall protection was not required by their employer
- 75 percent had not been trained on how and when to use fall protection equipment
- 60 percent were less than 35 years old

U.S. Railroads

An informal poll of U.S. railroads revealed that most had rules or policies regarding the use of fall protection, but many admitted that these rules and policies were not vigorously enforced.

Company rules and policies notwithstanding, the Occupational Safety and Health Administration has fall and climbing protection regulations that apply to railroads. There was a 1978 court case where an eastern railroad challenged OSHA on jurisdictional grounds relating to an OSHA-issued citation for failure to provide fall protection on a 35-foot high bridge where ties were being replaced. The Administrative Law Judge in this case found that the FRA did not displace OSHA's coverage of the working conditions on the bridge and the citation and fine were upheld.

Aside from obvious moral and ethical reasons for providing proper fall protection, there are sound economic reasons. The preventive approach may initially cost in terms of equipment, training and possible delays, but these costs are insignificant compared to the reactive approach of paying government fines, medical bills, legal fees and court settlements. The railroad industry's unique injury compensation system often results in astronomical personal injury settlements. A few years ago on a western railroad a B&B painter fell from a scaffold attached to a bridge. The man was not tied off and he was permanently injured. The final settlement exceeded $600,000. The cost of this single accident would have paid for a lot of fall protection and training.

OSHA Regulations

OSHA requires that fall protection be used when workers are working more than 10 feet above the ground or water surface. When work is being performed more than 25 feet above surface, safety nets must be provided where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines or safety belts are impractical.

When using lifelines, they must: (a) be secured above the point of operation to an anchorage capable of supporting a minimum dead weight of 5,400 pounds; or (b) be a minimum of 7/8-inch wire core manila rope where subject to cutting or abrasion. For all other applications, the lifeline must be a minimum of 3/4-inch manila rope or equivalent with a minimum breaking strength of 5,400 pounds.

Safety belt lanyards must: (a) be a minimum of 1/2-inch nylon or equivalent with a maximum length to provide for a fall no greater than six feet; and (b) have a nominal breaking strength of 5,400 pounds.

Safety belts, harnesses and lanyard hardware must: (a) be drop forged or pressed steel; (b) be cadmium plated in accordance with Federal Specification QQ-P-416; and (c) be capable of withstanding a tensile loading of 4,000 pounds without cracking, breaking or taking permanent deformation except for the rivets.

Safety Waist Belts

Fall protection can be classified by two basic types: Active systems and passive systems. The active system requires that the worker do something to ensure his/her safety. For instance, put on a safety belt or harness and attach the belt or harness to a secure location or rope grab device. Passive systems can be nets, catch platforms, temporary floors, guard rails, etc.

The safety waist belt with a lifeline or lanyard is the most common active safety system. The waist belt usually consists of a synthetic, or synthetic and leather, belt with one or two "D" rings. The belts fasten with a tongue and buckle system, like a dress belt, or with a single or double pass system where the tongue is passed through the buckle once (single pass belt) or brought back through the buckle (double pass belt). Tests have shown that single and double pass belts can withstand a great deal of impact loading. The tongue buckle will often fail at the tongue hole with severe impact loading.

When using a waist belt for positioning, that is, for holding a worker in place for rebar or form work, etc., use a double "D" ring, one at each hip. If the worker slips, this will pull him forward into the work area. When using the waist belt for fall protection, the "D" ring should be fixed in the middle of the back of the belt.

Lanyards

Lanyards are usually rope or strap. A rope lanyard should never be used around sharp radius objects where they will be subject to sharp bends such as over I-beams or angle iron. These bends can stretch the outside fibers of the rope while compressing the inside fibers, resulting in damage which is not always visi-

ble. Tying a lanyard in a knot can reduce its strength by 50 percent.

Strap lanyards are better suited for work around sharp edges or where the lanyard may be abraded. However, strap lanyards do not stretch as much as rope lanyards and, therefore, impact loading is greater if a fall occurs. This can be more than compensated for with a shock absorbing device which is built into some strap lanyards. The shock absorber is essentially webbing doubled over with a series of cross stitches. Impact energy is transmitted to these stitches, progressively breaking fibers and dissipating energy. Nylon and polyester are two of the most common lanyard materials. The manufacturer should be consulted for the best material for certain jobs. Nylon, for example, will quickly degrade in caustic atmospheres or in prolonged sunlight.

Lanyards should always be as short as possible and they should always be tied off as high as possible. This limits the distance of a fall and limits the amount of impact force exerted on the worker's body in a fall. The worker should never work above his tie-off point as this increases the distance of a fall and can exceed the six-foot maximum fall allowed by OSHA.

Snap Hooks

There are two types of snap hooks: Single lock and double lock. Double lock snap hooks lessen the possibility of the hook gate being inadvertently opened due to twisting motions or improper hookups. Accidental gate opening or "roll out" can occur if two lanyards are hooked together, if a lanyard is hooked onto itself or, in a fall, if the lanyard is hooked to steel cable. A double lock snap hook gate cannot be depressed without manually operating the locking device.

Full Body Harness

The full body harness is the best fall protection available for severe fall hazard areas or where personnel must be lifted or lowered. This system distributed impact loading stress to areas of the body that can withstand more stress than the abdominal area. With this system stress is distributed to the chest, shoulders, back, buttocks and thighs. The "D" ring is located in the upper center portion of the back and this keeps the worker upright during a fall. When a lanyard with a shock absorber is used with this system, impact stress is greatly reduced.

ASSE Study

In 1952 the American Society of Safety Engineers sponsored a research project on safety belts, harnesses and accessories. This study found that safety waist belts can cause serious injuries in falls. The research involved placing waist belts on anesthetized dogs and simulating fall arrests. Subsequent autopsies revealed a variety of internal injuries to liver, spleen and pancreas and congestive heart failure. While there were several limitations in this study and in subsequent French and British experiments, indications are that a full body harness with a dorsal lanyard attachment provides the best and least traumatic fall arrest protection. Additionally, French and American studies showed that human tolerance to suspension was far greater in a full body harness than with a waist belt.

Lifeline Systems

Lifeline systems are recommended in areas where workers must move often such as moving vertically up and down forms or back and forth across a bridge. Retracting lifelines are self-contained, automatically retracting lines that maintain a constant rewind tension so that there is no slack line. If the wearer falls, a centrifugal locking mechanism stops the fall within a few inches. These units are hooked to secure overhead lines. One disadvantage is that the lifeline must be plumb. A fall with the lifeline out of plumb could result in a pendulum motion which could severely injure the wearer.

The lifeline locking system is for vertical movement. A lifeline is secured vertically and fed through the locking system. The wearer connects his safety belt to the locking unit and can move up and down. If the worker falls, the unit automatically locks up. A disadvantage is that some of these units can be installed upside-down, resulting in no protection.

Fixed Ladder Fall Protection

OSHA requires that fixed ladders over ten feet be equipped with a fall safety device. Ladder fall protection systems usually consist of a fixed safety rail and a climbing sleeve that moves up and down the rail. The climber fastens his/her safety belt to the climbing sleeve which locks up if the climber falls. These systems can also be attached to poles. These systems are much easier to install than ladder cages, however, they may be affected by ice.

Safety Nets

Safety nets offer several advantages over the active fall protection devices just described. Nets are a practical way to protect large concentrations of people. When used with debris nets, they also protect people who may be immediately below the work site. Nets allow unhampered movement of workers and they protect the worker who might otherwise fail to use fall protection.

Here are the main OSHA requirements when using safety nets.

- — The nets must extend eight feet beyond the edge of the work surface and must be as close under the work surface as practicable.
- — Nets cannot be more than 25 feet below the work surface.
- — They must be tested on the job. The test must be done immediately after installation, after major repairs and at six-month intervals. The test consists of dropping a 400- pound bag of sand into the center of the net from 25 feet. There can be no broken strands or significant distortion of the net pattern or the suspension system.
- — The mesh size of the net cannot exceed six-by-six inches.
- — All new nets must meet the performance standards of 17,500 foot-pounds minimum impact resistance as determined and certified by the manufacturer and must bear a label of proof of test.
- — The edge ropes must provide a minimum breaking strength of 5,000 pounds.
- — Forged steel safety hooks or shackles must be used to fasten the net to its supports.
- — The connections between the net panels must develop the full strength of the net.

Several companies will rent and service safety nets as well as provide technical assistance in selecting and installing the nets.

Training

Finally, the key to successfully using any equipment is proper training. Ideally, initial fall protection training should be done by a fall protection manufacturer's representative. Several companies will provide on-site training that includes "hands on" demonstrations of the equipment. The following key points should be included in a training program:

When and why fall protection is necessary
- — potential for injury due to falling
- — past losses due to falls
- — changing conditions: Wind, weather
- — government requirements

How to assess potential fall hazards (supervisors)
- — type and duration of project
- — number of workers involved
- — tools and equipment to be used in project
- — other safety devices to be used: Life jackets, goggles

How to properly use fall protection equipment
- — "hands on" demonstration
- — choosing the right fall protection for the job
- — limitations of the equipment

Maintenance of fall protection equipment
- — when and how to inspect the equipment
- — testing of the equipment

Record keeping (supervisors)
- — keep a log of who was trained and when
- — record any updating of the training

Establishing a practical and effective fall protection program requires an understanding of the potential hazards when work is performed above grade. It is essential that supervisors and workers recognize these potential hazards and accept the logic for using fall protection. Achieving a positive attitude towards fall protection is the difficult part. Selecting the type of fall protection and establishing a training program can be done efficiently by consulting with the fall protection manufacturer. We have the technology and the knowledge to prevent fall injuries. We simply have to utilize this technology and build it into our daily work procedures.

Are there any questions? If not, thank you very much.

Mr. Bessey: Thank you, Mr. Kenyon. This is a very sensitive, but very important subject and it was an extremely informative presentation. If there are no questions, at this time I'll turn the program over to Don Lewis, our special features chairman. Don.

Mr. Lewis: Thank you, President Bessey. At this time I would like to introduce Mr. Wendell R. Moore, who will give a presentation on "Plywood Techniques in Concrete Formwork." Mr. Moore is manager of the North Central Region of the American Plywood Association. He is a Registered Professional Engineer in the State of Iowa and a 1950 graduate of Iowa State University. Since 1960 he has been employed by the American Plywood Association representing the interests of the plywood and structural panel industry primarily in Midwestern states. At this time it's my pleasure to present Mr. Wendell Moore.

PLYWOOD TECHNIQUES IN CONCRETE FORMWORK

Mr. Wendell R. Moore

Manager
American Plywood Association, North Central Region

Mr. Moore: Thank you Don.

The American Plywood Association is a nonprofit trade association voluntarily supported by 61 companies who operate 134 manufacturing facilities. These mills produce a variety of structural-use wood panels including plywood, waferboard, oriented strand board, composite panels and structural particleboard. Plywood has been available since the early 1900's but the newer products; i.e., waferboard, oriented strand board, etc. have been available only 10 to 15 years. This presentation on concrete forming will concentrate on the properties and uses of plywood. A performance standard for concrete forming is under development that will include all non-veneer products, but it is a year or so away.

The American Plywood Association is headquartered in Tacoma, Washington. There are nearly 200 employees involved in promotion, quality assurance, research and development and engineering services. One of the most important functions is to provide a quality assurance program for the member mills. This is accomplished through certified inspectors in the mill and APA personnel who train and check on the performance of the inspectors. Plywood is manufactured in conformance with an industry-wide Product Standard identified as PS 1-83. This standard is a lengthy document with specific requirements that are spelled out in detail. It is generally termed a prescriptive document. Tolerances are established for the panels in width, length and thickness.

Other activities of the American Plywood Association involve personnel who are available to advise and recommend the proper use of the structural panels. The APA has five regional offices in the United States with 25 representatives located in major market areas. These representatives are available to assist building officials, designers, builders, lumber dealers and customers.

With that as an introduction, I'd like to briefly discuss the manufacture of plywood. The industry works with logs that are typically 12 inches in diameter or greater, cut to a predetermined length, normally 101 inches. The logs are placed in a lathe and spun against a razor-sharp knife that peels the veneer off the circumference of the log. The veneer is then dried, graded and possibly repaired. The veneers must be dried to five percent moisture or less to insure a consistently good glue bond. The veneers are then assembled into the typical plywood panel with the layers of wood assembled such that they are at right angles to adjacent layers. Almost all of the glue used in the softwood plywood industry is a waterproof-type adhesive. Generally, glue is placed on one surface and the glue then transfers to the adjacent surface when pressure is applied. A hot press is used to cure the glue and apply the pressure.

A variety of woods can be used in the plywood industry. In the early days, plywood was manufactured from Douglas fir; as the industry expanded, additional western softwoods were used and finally in the 1960's, the industry expanded into the south and began to manufacture plywood with southern yellow pine veneers. Southern pine is used extensively in the production of plywood today.

There are 70 different species listed in the Product Standard and they are divided into four major groups. They are identified as Group 1, the strongest, through Group 4. Group 1 woods include Douglas fir, southern pine and larch. Group 2 woods include hemlock, white fir, etc. Group 3 woods include redwood, and Group 4 woods include western red cedar. Obviously, the strongest wood species produce the strongest plywood panels.

Plywood panels are identified with a trademark that includes strength information. Often the group number is a part of the trademark. A panel identified as Group 1 will have Group 1 woods used for the face and back of the panel. On many panels though, the inner plies, the crossbands and center ply, could be a Group 4 wood.

Veneer quality and appearance is also identified on many trademarks. The best grade of veneer that is typically available today is ''A'' grade. This veneer grade is sanded to be smooth and is considered suitable for a paint finish. There is a limit of 18 repairs, either wood or synthetic, in a four foot by eight foot panel face. ''B'' grade veneer is described as solid and can have any number of repairs and plugs. ''C'' grade veneer has knotholes of one inch diameter, a few up to one and one-half inch diameter, and ''D'' grade veneer has the largest knotholes — two and one-half inches to three inches in diameter. With these veneer grades, up to 30 different panels can be manufactured.

There are different exposure capabilities for the panels. Exterior type plywood is suitable for permanent exposure to the weather. It is made with a waterproof glue called phenolic formaldehyde that is cured with the application of heat and pressure. Exterior type plywood is also made with ''C'' grade veneer or better, so even the inner plies will have limited void areas.

The most commonly available panels are labeled Exposure 1. This also means the panel is made with a waterproof adhesive but the core and back of the panel is typically a ''D'' grade veneer and this means the panels may contain knotholes up to two and one-half to three inches in diameter. Exposure 1 panels are used in many construction applications such as roof sheathing, subfloors and wall sheathing. In these applications the panels may be exposed to the weather for a considerable time while the building is under construction but eventually the structure is closed in and the panels are not permanently exposed to the weather.

Mills also may produce panels labeled Exposure 2. These panels would be suitable for short term exposure to the weather. The best estimate is that 99 percent of the construction grades of plywood are produced with waterproof adhesives. It is possible to buy hardwood paneling or plywood with an interior-type adhesive, generally urea formaldehyde.

The most common grade of plywood used for concrete forming is called B-B Exterior. Rather than use group number, the panels are identified as Class I and Class II. The Class I panels are the strongest. The most commonly available thickness is 23/32 inch, then ¾ inch, but either 19/32 inch or 5/8 inch thick panels are also produced. The panel is an exterior-type plywood with a waterproof glue. Typically, the panels are fully sanded, mill oiled and edge sealed. The thickness tolerance for sanded plywood is plus or minus 1/64 inch. The width and length tolerances are zero inches, minus 1/16 inch. The panels are to be square and the edges straight.

To understand plywood properties, grades and exposure durability, I would like to review some basic data regarding plywood. First, it is made with veneers assembled at right angles such that there is a two-way strength with the panel. The species of wood used will affect the strength of the panel. There are over 70 different species that may be used but Group 1 woods of douglas fir and southern pine are most common. Many panels are identified with a group number to indicate the strength characteristics.

Another consideration is the quality or grade of the veneer A-B-C-Cp.-D, the veneer obviously affects the appearance and has some effect on the strength assigned.

Glueline is also important. Exterior is the most durable. Exposure 1 panels are made with exterior type glues but allow the use of ''D'' grade veneer. Exposure 2 would be hard to find.

The most common grade of plywood used for concrete forming is APA B-B Exterior Plyform, Class I, as identified by this grade-trademark on the panel. Three-fourths inch is by far the most common thickness used, followed by 5/8 inch. This is a fully exterior-type panel with water-proof glue bond. These panels are sanded on both sides and oiled at the mill, unless otherwise specified. The requirement for panels is spelled out in PS 1-83 Product Standard for the plywood industry. High Density Overlaid Plyform Class I and Class II meet the same general specifications as Plyform Class I and II. Both classes of HDO Plyform have a hard, smooth, semi-opaque surface of thermosetting, resin-impregnated materials that forms a durable, continuous bond with the plywood. HDO Plyform is most often specified when the smoothest possible concrete finishes are desired. Both sides can be used with equal effectiveness.

Structural I Plyform is stronger and stiffer than Plyform Class I or II, and is specifically designed for engineered applications. It contains all Group 1 wood species, and is often recommended for high pressures where face grain is parallel to supports. HDO Structural I Plyform is also available for use where maximum number of reuses is required.

Maximum performance and reuse of Plyform can be assured through proper handling and care of the product. This includes proper storage, stripping and cleaning and oiling the forms between pours.

During storage outdoors, the panels should be kept out of the sun and rain. If plastic sheets or tarps are used, anchor them at the top of the stack, but keep them open and away from the stack sides and bottom to assure good air circulation and ventilation around the panels. Tightly wrapped coverings prevent air circulation and, when exposed to the sun, will create a virtual "steam chamber" which can result in mold formulation.

In stripping the forms, metal bars or prys should not be used on plywood. Use wood wedges, tapping gradually when necessary. Plywood's strength, light weight and large panel size help reduce stripping time. Cross-laminated construction resists edge splitting. Care should be exercised to prevent panel chipping, denting and corner damage during handling. Panels should never be dropped.

Soon after removal, plywood forms should be inspected for wear, cleaned, repaired, spot primed, refinished and lightly oiled before reusing. Use a hardwood wedge and a stiff fiber brush for cleaning (a metal brush may cause wood to "wool"). Light tapping with a hammer will generally remove a hard scale of concrete. Specifications should be checked before using any oil or compound on the forms. A frequently used mill oil is 100 or higher viscosity pale (color) oil. A liberal amount of oil or parting agent, applied a few days before the plywood is used, then wiped so a thin film remains, will prolong the life of the plywood form, increase its release characteristics, and minimize staining.

Lacquers, resin or plastic base compounds and similar field coatings sometimes are used to form a hard, dry, waterproof film on plywood forms. The performance level of the coating is generally rated somewhere between B-B Plyform and High Density overlaid plywood. In most cases the need for oiling between pours is reduced by the field applied coatings.

There are five basic steps involved in the design of plywood concrete formwork. The APA brochure, "Plywood for Concrete Forming", contains detailed information on each of these steps, with useful tabular design data.

Let's take a quick look at each of these steps. First, we must determine the maximum concrete pressure for our design. It will depend on such things as pour rate, job temperature, concrete slump, cement type, concrete density, methods of vibration, and height of formwork, in the case of columns and walls.

Table 1 in our manual gives concrete pressures for columns and wall forms, for vibrated concrete at two temperatures, assuming 150 pcf concrete and four inch slump. Another chart in the manual gives pressures for other temperatures and pour rates.

Table 2 gives concrete pressures for slab forms, allowing for weight of motorized or non-motorized buggies and workmen.

Next, plywood thickness and support spacing is determined. It is usually best to use one thickness of plywood and vary the framing spacing for different pressures.

Tables 3 and 4 give this information for six plywood thicknesses, from one-half inch to one and one-eighth inch, and various support spacings. It is based on Class I Plyform at a deflection limitation of /360 for architectural applications. Table 3 is based on face grain across supports, and Table 4 is based on face grain parallel to supports.

Table 5 has the same information for Class I Plyform at a deflection limitation of /270. This would be for non-architectural uses where appearance is not critical. There are similar tables in the manual for Class II and Structural I Plyform.

The next step is to determine framing loads, sizes and spacing. The loads carried by joists for slab forms or studs and wales for wall forms are proportional to their spacings as well as the maximum concrete pressures.

A typical nine foot high plywood wall form is illustrated here, showing use of five-eighths inch Class I Plyform applied across 2 x 6 studs at twelve inch centers, which are in turn supported by double 2 x 6 wales at forty-six inch centers. Tie spacing is thirty-three inches.

Plywood forms are frequently prefabricated in large or small sections for ease of handling, erection and stripping. These are lightweight, prefabricated forms being erected near the top of the huge concrete dome stadium in Seattle.

In most forms, it is best to attach the plyform to the framing with as few nails as possible. For slab forms, each panel must be at least corner nailed. Use 5d nails for five-eighths plyform and 6d nails for three-quarter Plyform. In special cases, such as gang forms, additional nailing may be required. Do not butt panels too tightly, especially on the first pour.

Here is a section through a typical wall form showing plywood, studs, double wales, and tie bolts in position. Here are snap ties in position on a wall form. The plastic cones are subsequently removed from the concrete, resulting in an accentuated tapered hole at each tie location. This is a special strong back or waler bracket to facilitate alignment and anchorage of the doubled wales to the studs. Here the wales are anchored to the bracket, using a conventional snap-tie plate. A snap-tie and plate are also in position on the right.

The use of a through-bolt and threaded plate for anchoring a wall form is illustrated here. The tie-plate to the right anchors the wales to the waler bracket on the studs. This wall form, using High Density Overlaid Plyform, shows snap ties and tie plates in position. The picture was taken following the pouring operation.

Plyform is definitely the preferred material for curved forms, because of its flexibility and strength. A table showing the minimum bending radii of various thicknesses of plywood, both parallel and perpendicular to face grain, is on Page 22 of our concrete form manual.

Thin shell barrel vault roofs, like this one in Phoenix, Arizona, are poured against curved three-fourths Plyform.

For tight curves, such as the flared top of this integral column and roof slab form, one-fourth A-C Exterior plywood is often used over closely spaced ribs.

The number of reuses obtained from Plyform depends to a great extent on handling and care discussed earlier and the system being used, as well as the surface coating or overlay on the panel.

Many more uses can be expected from HDO Plyform and from proprietary metal frame systems. This is Symons slab shore system showing some very old HDO forms along with some new forms. As many as 200 reuses have been recorded with HDO forms and 50 to 200 reuses are not uncommon, given reasonable care. Regular Plyform is reported to give from five to ten reuses by a major user, although in a proprietary metal framed system up to 100 reuses have been reported.

Here is an example of HDO Plyform that has been reused more than 330 times. Although the overlay changes to deep purple, the panel is suitable for reuse.

I did provide copies of the APA publication on Concrete Forming and you are welcome to take one with you. If you have questions regarding plywood and structural-use wood panels, you will find the addresses and names of the managers of the five regional offices for the APA on the back page. You are also invited to direct any inquiries to our Chicago office. Thank you very much for the opportunity to be with you today.

Mr. Bessey: Thank you very much. You know, we use plywood and we specify it. We look it up in a table, but I don't think we know that much about it.

Just to clear up a point, if you are new in our organization or didn't know and didn't want to ask, this presentation was what we call a special feature. A special feature is when an expert, like Mr. Moore, talks about a particular product. A special subject is what the blue card is all about. We have a chairman and we have a sponsor and we have a year to put these special subjects together. So we ask you to fill out a blue card that can be found on the table at the back of the room and sign up to participate on a special subject committee either as a chairman, co-chairman or a committee member. Our next special subject will be introduced by Ed Bond, sponsor of the report.

Mr. Bond: The next subject that we are going to discuss is "Preparation of Bridges for Protective Coatings." I would like to introduce Frank Gibson from the Norfolk and Western at Roanoke, Virginia.

SPECIAL SUBJECT NO. 2

Preparation of Bridges for Protective Coatings

Chairman: F. R. Gibson, Eng. Struct., NS Corp., Roanoke, VA

Introduction

The subject of bridge painting could be approached from several different angles. However, the Spring issue of the B&B Newsletter confined the subject to "Preparation of Bridges for Protective Coatings". This subject will be mainly a review of some of our present methods of cleaning bridge steel.

Everyone is aware that we have been trying for years to arrest corrosion on bridge steel and our efforts have resulted in many new sophisticated, hi-tech coating materials on the market today. It is anticipated these materials will protect the surface of steel over a longer period of time and reduce the labor cost by reducing the frequency of steel repairs and frequency of cleaning and recoating. Surface preparation is the most important single factor in the performance of these coatings. From the beginning, it is also noted that surface preparation is the most expensive portion of coating bridge steel. It has been determined that approximately 80 percent of the total cost of coating bridge steel is for surface preparation.

One item that should not be taken lightly is a bridge painting program. A comprehensive bridge painting program is necessary to keep the progression of bridge painting going in a timely fashion. Painting programs are based on the total amount of surface area of steel on a system and how much area is going to be painted each year, projected paint life, amount of manhours available each year, equipment available, and the degree of surface preparation. A progress report portion of the program should be included to monitor the monthly activity.

Surface Preparation

The life of a coating depends as much on the degree of surface preparation as on the selection of the coating system. The amount of surface preparation, therefore, should be thoroughly considered. There are two basic reasons for surface preparation.

(1) To remove all surface contaminants that will cause premature failure.

(2) To provide a prepared surface that can be easily wetted for good coating adhesion.

It is a fact that all coating systems will eventually fail. However, an adequately prepared surface will reduce the chance of premature coating failure.

Contaminants that require removal are dirt, dust, moisture, oils and greases, salts, rust and any corrosive materials. Mill scale may or may not require removal. This decision is based upon the tightness of the mill scale, type of primer to be used, and the severity of the environment.

There are several methods of cleaning bridge steel and these methods are described in the Steel Structures Painting Council Manual, Surface Preparation Specifications. The degree of cleaning should be based on the recommendations of the manufacturer supplying the coating. Before any coating is applied, the surface should be thoroughly inspected to insure it has been properly cleaned. Pictorial standards are available for aiding inspectors in their evaluation of the cleanliness of the surface.

The following is a review of some of the different types of cleaning and surface preparation methods:

Hand Tool Cleaning

Hand tool cleaning is defined as a method of preparing steel surfaces by the use of non-power tools such as wire brushes, putty knives, abrasive cloth, scrapers and impact hand tools. This methods requires the least investment in the purchase of necessary cleaning tools. Hand tool cleaning should be limited to small areas and the areas cleaned by this method should be coated using paints with good wetting ability. Hand tool cleaning removes all loose mill scale, loose rust and other foreign matter. It is not intended that tight mill scale, rust and paint be removed by this method.

Power Tool Cleaning

Power tool cleaning is a method of preparing surfaces by the use of power assisted hand tools such as power needle guns, power wire brushes, paint strippers and grinders. This method should be limited to small areas. The degree of cleaning is similar to hand tool cleaning.

Water Blast Cleaning

Water blast cleaning, sometimes referred to as hydro cleaning, is a method of removing contaminants by the use of high pressure water spray. There is a variety of water blast cleaning equipment available with different options. This equipment can be used with sand injectors which are capable of removing rust and mill scale. Due to the pressure at the nozzle which can go beyond 10,000psi, nozzlemen have to be changed regularly because of fatigue. It appears that the combination of high pressure and hot water would rapidly remove old grease paint; however, the rate of its removal is much slower than by conventional sand blasting.

Sandblasting

Sandblasting appears to be the most popular method of cleaning bridge steel, since many new paint systems require a sand blasted surface. This method of cleaning requires the most investment in equipment. Virtually all surface contaminants can be removed by sandblasting and an anchor pattern created for good coating adhesion. There are four grades of sandblast cleaning defined in the Steel Structures Painting Manual:

1. Brush-off blast
2. Commercial blast
3. Near white metal blast
4. White metal blast

The choice of a particular grade is a matter of economics and should also be based on the coating manufacturers' recommendation.

The selection of suitable blast grit is important in sandblast cleaning. Blast grits should have sharp angular corners and should include a gradation of particles ranging from coarse to fine to produce the surface profile desired. Blast grits are usually packaged in 100 pound bags for handling and ease of loading sandblast hoppers. Blast grits can also be purchased in bulk quantities at a cheaper rate than bag quantities; however, special equipment is required for handling it.

Sandblasting requires large quantities of compressed air. A one-half inch diameter nozzle, which is probably the most popular size nozzle for cleaning bridge steel requires 338 CFM at 100 psi. The best advice when either purchasing or renting sandblasting equipment it to think big.

The Steel Structures Painting Council has a video training tape available covering the subject of surface preparation and is a valuable tool for training field people.

Thank you for your attention.

President Bessey: Thank you, Mr.Gibson and Ed, for that fine report. Don Lewis will introduce the next special feature.

Mr. Lewis: Thank you, President Bessey. I would now like to introduce Mr. David C. Bender who will give a presentation on industrial applications of concrete block pavers. Mr. Bender is appearing on behalf of the National Concrete Masonry Association and Mr. Heslip. Mr. Bender is president of the Pavestone Company. He holds a Bachelor of Science degree in civil engineering from Ryerson University in Toronto, Ontario, Canada. Mr. Bender has worked with commercial contractors and consulting engineers specializing in precast concrete construction. Since 1970 he has been active in the production and installation of concrete pavers and has been involved in several heavy industrial-use projects. Mr. Bender is an active member of the Paver Committee of the National Concrete Masonry Association and also chairman of the Paver Committee of the National Precast Concrete Association. He is also a member of the Society of American Military Engineers. At this time I would like to present Mr. David Bender.

INDUSTRIAL APPLICATIONS OF CONCRETE BLOCK PAVERS

David C. Bender

President
Pavestone Company

Good afternoon. The topic today is going to be the use of concrete pavers in industrial applications. How many of you have used concrete pavers on your properties? Looks pretty exclusive to me. How many of you don't use concrete pavers? Okay. Well maybe I'd better make sure that with a protype topic like this you believe everything I am going to tell you.

I'm going to tell you about my experiences with a three-legged chicken. I was driving down one of those farmers' market roads in Texas last week doing about 50 miles an hour and lo and behold, a chicken was racing past on the right side of the car. I looked at this chicken and this chicken had three legs. It just appeared before my eyes. I kept right on going and several moments later I looked in my mirror and I see another chicken in the rearview mirror again. So I picked up my speed, 50 to 70 miles an hour, and this chicken just went whizzing by me again. Well, I was determined not to have another chicken pass me again so I speeded up to 90 miles an hour and here this chicken comes along again and just passes me up. But this time it turned to the right just ahead of me and I decided I was going to follow this chicken. So I turned in and followed the road a minute and I ended up in a chicken farm and there were chickens all over the place. I parked the car and a gentleman came out of the house and asked me what I was doing and I told him how curious I was about the chickens that had been passing me out on the road at 90 miles an hour and wondered if there was racing in town. And the farmer said "Well, they are a specialty bird. They have the finest quality drumstick that you can get." So I inquired about the genus of them and asked him if he had ever tasted one and what did they taste like. He said he didn't know. So I asked, "Well what do you eat?" Fastest birds I'd ever seen and he hadn't tasted them yet! He said "Well, the problem is you can't catch them to eat them!" (Laughter)

(Whereupon there was a slide presentation)

President Bessey: Thank you very much. Our program is now over for today and we will meet tomorrow morning at 8:30 sharp, not nine o'clock, 8:30. We will be in joint session with the Roadmasters in the Grand Ballroom on the fourth floor. After the joint session, we will come back up here about ten o'clock. So for today, the session stands adjourned.

TUESDAY MORNING JOINT SESSION
September 16, 1986

President Moorman: Good morning. On behalf of the Roadmasters and Maintenance of Way Association of America and the American Railway Bridge and Building Association, I would like to welcome you to the second joint session of this conference. I will now call the meeting to order. At eight o'clock this morning our registration stood as follows: Roadmasters, 182; B&B, 66; Associates 184 and guests, 52, for a total of 484 people. That is down as of this time, I think, somewhere between 60 and 70 from 1984.

As our keynote speaker this morning we're especially privileged to have with us Mr. E. B. Burwell, President of the Southern Railway. Mr. Burwell attended VMI and graduated with a degree in Civil Engineering and then entered service with the Southern Railway in 1952 in the management trainee training program. Mr. Burwell spent about two years in the engineering department and served as track supervisor in Sheffield, Alabama. Then he apparently saw the error of his ways and moved to the transportation department. Since that time he has held various positions in the Southern Railway operating department, including assistant trainmaster, trainmaster, assistant superintendent and superintendent, general manager, vice president transportation and vice president of operations. At the time of the Norfolk Southern merger between the Southern Railway and Norfolk and Western Railway, he became the president of the Southern Railway. There is not much else I can say other than Mr. Burwell does play golf and, therefore, is a pretty good guy. It is my great pleasure to introduce Mr. E. B. Burwell.

KEYNOTE ADDRESS

E. B. Burwell

President
Southern Railway

E. B. Burwell

Thank you, Wick. I think I have a few credentials that probably associate me with the Roadmasters and the Bridge and Building Associations. In 1952, the first day I went to work for the railroad, they assigned me to a section gang in Knoxville and put a tamping fork in my hand. I spent about six weeks on the business end of that tamping fork. Later on I was assigned to a bridge gang and had the job of catching hot rivets out on a bridge. I'll have to say after a couple of years of doing that, the thought occurred to me quite a few times in some of those jobs that there must be a better way to do them. I'll have to say this, our engineering people have, since 1952, made great strides in finding a better way to do the jobs that they were assigned. I haven't seen any tamping forks around the railroad in recent years and haven't seen anyone catching hot rivets either. It is a real pleasure and an honor for me to come up and talk with you today, because you people in the maintenance of way and the bridge and building really are involved in what is the very foundation of the railroad industry, literally speaking. But I guess what I'm here today to tell you is it is time we stopped talking about the railroad industry and start talking about the transportation industry. Railroads really are only a part, and I might add a very vulnerable part, of an intricate network of ways to get item A from point B to point C. And I say a vulnerable part of this network because our grip on item A is very tenuous. I'm not aware of a single shipper who ships by rail simply because he likes rail and wouldn't ship by any other means regardless of how much it cost or how much service was offered. Why should he ship by rail if another mode is ready to bend over backwards to give him exactly the service he needs, exactly when he needs it, and at a lower price. That, gentlemen, is what we are faced with every day. He won't, of course, ship by rail just because he likes rail. I wouldn't do it and I'm sure you wouldn't. In fact, anybody with a grain of sense, any business person, wouldn't do it just because he liked the mode of transportation. So I say to you, welcome to the transportation industry. It is a tough place to do business and it is getting tougher every day. Especially, if like the rail industry, your labor costs reflect the business climate of another century, and you have to build and maintain your own roads while the roads your competitors use are built by the taxpayer.

In the transportation industry of the 1980's, the inter-dependent network of rail systems with uniform rates and tariffs and "you'll get it when it gets there" outlook on service has become a thing of the past. The trend today is toward increasing fragmentation of the railroad network as each railroad goes its own way looking for a higher market share and better profit margins. Joint routes are canceled, state railroad associations are being dissolved, and there is talk of cutting back or even liquidating Trailer Train as individual railroads seek their own solutions to the problems of intermodalism. Cooperation, which we had much of in the past, is giving away to competition, but really this is the way it should be. All of this creates turmoil and that is something we are going to have to live with. Too many of us have become too comfortable with the archaic ways our business has been conducted. Faced with the need to act like business people, we have had to learn an entirely different set of rules and, quite frankly, a lot of us have become very uncomfortable in that environment. But the condition we will have to adapt to is a very desirable one and that is a deregulated environment.

Well, you ask, how well have we adapted and the results are somewhat mixed. You know some years ago every time you picked up the paper you read that the railroads were headed toward nationalization. I am sure all of you recall that. It hasn't been too long ago. Well, we have switched off the track toward nationalization and hopefully we are back on the track toward profitability. I think sometimes our customers have probably benefited even more than we have as the scramble for market share in the newly market-oriented system has come about because they are getting lower rates and better service. The railroads, unfortunately, are losing some market share as a result of this. But in the last couple of years it appears that our drop in market share has somewhat stabilized with respect to the truckers.

Let's take a closer look at that last point. Between 1971 and 1984 rail ton miles grew about 25 percent. In the same period, the industrial production index grew 49 percent. So the growth in ton miles didn't track the growth in the industrial production index. In fact, most of the commodities traditionally carried by rail have declined and I am sure all of you have seen that. Apparently, the stabilization of the rail market share is due almost entirely to growth in ton miles of western coal. The 1985 rail traffic levels were four percent below 1984 and it appears that 1986 will either be flat with 1985 or maybe down one or two percent. Basic materials, coal and grain, are moving very slowly. The automobile industry is not experiencing one of its best years and, of course, those things are likely to hurt us. Merchandise traffic is either flat or a little bit better but, unfortunately merchandise traffic is highly competitive and our profit margins are very slim. From the standpoint of increasing traffic, intermodal is our brightest hope. But, unfortunately, it is also our least profitable business, and we haven't yet learned how to handle intermodal business at a profit margin we need.

As you fellows who have been in this business for some time probably know, when business goes off the maintenance of way people have to pick up the slack. I am sure there are some of you here who remember back in the dark days of regulation a curious phenomenon called a "standing derailment". I'm not predicting a return to those conditions, but the pressure is increasing to find ways to perform our work more cheaply and better in order to maintain the property consistent with the demands that are made on it.

As I said in my opening, you gentlemen have made great strides in improving the productivity of our maintenance in both track and bridge forces. When I first went to work for the railroad in 1952 and was assigned a track supervisor's job, we had section gangs. Those have given way on our property to highly mechanized system gangs who can do more work in a day's time than a section gang might do in two years. So there have been great strides made in improving productivity in the maintenance of way and the bridge and building areas. Unfortunately, we haven't reached the end of that yet, and it is going to become necessary that we improve our productivity in those areas even more.

Despite traffic declines, the financial wellbeing of the railroads overall is pretty good today. Most of our improvements this year, though, have resulted or are the direct result of cheaper diesel fuel. Otherwise, maintenance of way and bridge and building would have been under a lot more pressure this year than they have been. A comparable drop in diesel fuel next year doesn't appear to be in the cards.

For those railroads with flat or declining profits, the new tax laws will create additional problems for maintenance officers. On average, the industry pays a four percent effective tax rate. Now that is the entire industry. Under tax reform, the minimum corporate tax of 20 percent will result in reduced cash flow that might otherwise be used for maintenance. The more profitable railroads, of course, will not be affected as greatly. This is a very capital-intensive industry. Because of that the railroads have made extensive use of the investment tax credit to rebuild our property. Over the past seven years, railroads have invested thirteen and a half billion dollars in new tracks, yards, and terminals. The investment tax credit permits a tax liability offset of up to 10 percent of new capital assets, but, as you all have read and I'm sure know, it now appears that we are going to have to live without the investment tax credit.

Further pressure will come from lengthening of the minimum depreciation schedules under the new law. The minimum term now for depreciating track is five years. Under tax reform, it will be seven. We will, however, be able to take a larger share of that depreciation up front. We can take some comfort from the fact that the original plan was to extend the minimum for track to ten years.

The result of all of this is that the after-tax costs of building and maintaining track is going to be much higher. Other capital intensive industries have the same problem and, unfortunately, a lot of these capital intensive industries have been our best customers in the past. They are going to be similarly affected with a cost finding decline in capital investment. They won't be able to modernize as fast and they are going to become less competitive internationally. The end result of that is going to be they are going to produce fewer carloads for us to handle. That is what Mr. Briggs of the AAR called "double whammy", the effects of tax reform on our customers combined with the effect of tax reform on our own industry.

Finally, we have to contend with rate compression. The downward pressure on rates created by competing modes is squeezing us against the cost of doing business and I must tell you there is little prospect of any relief with respect to rate compression. Our competitors are not going to raise their rates which permit us to raise ours. The only option left to us is to reduce our cost of doing business. Now I'm not telling you folks all of this just to cast a spell of doom and gloom over your association meeting. I'm sure most of you are probably already aware of some of the things that I have said. What I am leading up to is that the rail sector of the transportation industry faces a probable decline relative to other modes. And that presents special problems for you people who are involved in maintenance of the railroads.

How then can we continue to provide our railroads with the best track under increasingly stringent budget constraints? Well, there are two options. One, of course, we can reduce the wear and tear on rail and ties simply by using them less and, finally, that will lead you down the road to going out of business completely.

Or we can reduce our costs and become more productive. Unfortunately, the latter is by far the most difficult course of action. It seems to me that as maintenance officers you are going to have to work smarter; you are going to have to work harder; and you are going to have to know exactly what you are doing. Our crystal ball has to tell us not only how much traffic we are going to have to maintain the railroad for but what kind of traffic. Will the trains be short and fast? Trains are slow and heavy and you are going to have to maintain the railroad for high-speed rail/highway trains or slow coal drags or possibly both.

The difference, of course, is crucial because it dictates what kind of a maintenance program you are going to have. For example, you find there is a demand for running a light, fast, piggyback train from point A to point B. To be competitive with truck service, it has to make that run in ten hours. One of the problems you could be faced with is that part of that route is used primarily for hauling slow, heavy coal trains through the mountains. The track is being maintained for that heavy traffic. It isn't elevated around the curves to the degree necessary to accommodate a fast train. You can slow your merchandise intermodal trains down over the route, but then you won't make the schedule in the required time. You can elevate the curves to elevate the fast train, but then your rail wears out faster when the coal trains roll over it.

Where is the happy medium? That all depends on what volume of which traffic you forecast for that track. If you elevate the track for the fast traffic and realize low merchandise volume, you will be wasting money on replacing worn out track. On the other hand, the business you lose by not elevating the track and thus not running the train fast enough, may cost you more than the additional track maintenance would.

That brings us up to another point. We cannot afford and we will not let the quality of our track deteriorate. We are under more and more pressure to meet or beat the time schedule that trucks operate on. I see it every day. A marketing man comes in and says "Here is the truck schedule. What can you do?" Obviously we can't compete if the railroad is covered up with a bunch of slow orders. We've got to run some of our trains faster and that is going to require nothing less than the best maintained rail.

Now we can help you maintenance people to some degree by rationalizing the system and eliminating quite a few lines that no longer are profitable. And I am sure all of you have been involved in that with your respective companies. We can't expect you to maintain large sections of track that don't produce any profit and eat up your maintenance dollars. So, you have seen it, and we are seeing it: the move toward eliminating light density lines and rationalizing the system to let you concentrate your maintenance dollars where they will be most effective.

One of the biggest things our marketing people talk about in dealing with our customers is reliability. That seems to be the magic word and I hope that maintenance people will appreciate the importance of reliability, and when the budget crunch comes they will roll with the punches, but will not let the slow orders back up on us.

Of course, that is easy to say. It is going to require a special kind of person in the maintenance area. We are going to have to have well-trained maintenance officers, who must be in charge of their own budgets from preparation to administration, so that their performances can be measured. He is going to have to keep informed about the problems and challenges of the transportation industry. This will help him to understand and project the needs of track maintenance. He has to know where and when to make cuts in programs, materials, and people and where and when not to.

As railroads become larger, and we have seen that in the number of mergers that have been becoming larger and more complex, more responsibility is going to be pushed down to the lower echelons. We are going to have to have the right people there so that the right decisions are made at the proper time. We need full time people on the operational side. By full time, I mean full time — twenty-four hours a day, seven days a week. Unfortunately, the railroad business is not a five day week, 40 hour week operation. The wheels are turning every day, 24 hours a day. The new people that we employ should be made to understand that and be prepared for it.

Organizations like the Roadmasters and Maintenance of Way Association and the American Railway Bridge and Building Association are vital to the education of maintenance of way officers. Our company encourages our people to participate in these programs, to go to the meetings, and to serve on the committees.

In addition to mastering today's challenges, maintenance officers must look ahead and anticipate the challenges of tomorrow. We have had challenges before in the railroad industry. Some of them we haven't met very well, some of them we have met well. We are still here though and that is proof of something. We are still in the business. There is a great challenge that lies ahead. Railroads are much more successful than they were eight, ten or twelve years ago, but they won't remain that way unless we meet the challenges that are out there in front of us. It is not going to be easy, nothing ever is. I guess the word I am going to leave with you is, we are going to have to get more productive. Sometimes I get the impression, probably wrongfully so, that we do some things or get some things because it would be nice to do them or nice to have them, but not necessarily because we absolutely need to do those things or need to have those things. We need faster, shorter, more reliable trains to compete with the truckers. That is who our competition really is. We have to learn to think like a trucker because that is where the business is. Just remember one thing, ladies and gentlemen, we are in the transportation business. We are no longer just in the railroad business. There is a great challenge ahead of us.

I thank you very much for listening patiently to me this morning and my best wishes for a productive conference. Thank you.

President Moorman: Thank you, Mr. Burwell. I know that you have touched on a lot of areas about which there has been a lot of discussion by the members of our association and I know you have provided a lot of insight as to some of the changes headed for us and some of the challenges that we will have to meet.

At this time I would like to turn the program over to our conference chairman, Steve Hill, to introduce our next speaker.

Mr. Hill: Thank you, Wick. I listened with interest to Mr. Burwell's remarks, and one point that he made was about the need for the larger railroads to do a lot of rationalization of their systems. Rationalization does not mean those lines disappear as our next speaker will tell you. He is David Smoot, 29 years of age, and a fourth generation railroader. Mr. Smoot has a bachelor's degree in administration from Indiana University and while going to school, he served on the State of Indiana's Railroad Operations and Track Inspection Bureau. He also served as director of railroad planning for the state and assistant director of the transportation department for the Public Service Commission. Currently he is vice president and chief operating officer of Indiana Hi-Rail and is one of the three founding partners of that company which was formed in 1981. He is going to talk to us on what happens to some of those lines that the Class I's rationalize. Mr. Smoot.

MAINTENANCE PRACTICES ON SHORT LINE RAILROADS

David L. Smoot

Vice President and Chief Operating Officer
Indiana Hi-Rail Corporation

First, let me say that it is a pleasure to be asked to address the Roadmasters and Bridge and Building conference here in Chicago. I want to open by saying that indeed the major Class I railroads have rationalized their markets in the past several years, and probably took their greatest change back in the Penn Central days with the creation of Conrail. That was certainly when the term "short line" came up and became rather a household word in the railroad industry.

Indiana Hi-Rail Corporation began in 1981 and we are the nation's first actual feeder line railroad under the Staggers Act. Back in 1980 and 1981 we identified a railroad line in Connersville, Indiana, that was approximately eight miles in length. Conrail had the line under study for abandonment, but had not processed abandonment papers. We went to the ICC and forced that sale. That was the start of Indiana Hi-Rail. From those eight miles we now operate a total system of 101 route miles. We are one of the latest buyers of the ICG Railroad. We bought their line into Evansville, Indiana. We do serve some very major customers. Ford Motor Company is one of our major customers as is PB&S Chemicals, which is the twelfth largest chemical bulk breakdown people in the nation. We also serve a port on the Ohio River, probably one of the few independently served ports now. So this is some background on Indiana Hi-Rail. We annually handle about 6,000 carloads and we are a major bulk mover. I think if you check back on the scenario of what the major Class I railroads are doing now with their competition with trucks, that is our same market area. We are not out there for high speed merchandise traffic. Many of the lines we analyze for possible purchase in the future don't handle that kind of traffic. But at the same time, we have to erase a thing that we call "brakemen's syndrome" and many of you are probably familiar with it. Sometimes train crews tend to think that if they are moving a car there must be traffic down there and that their parent railroad is probably not treating that customer very well. They can't understand why there is an abandonment. Well, I can tell you, folks, that Indiana Hi-Rail as a short line or as a switching and terminal carrier, which is what we prefer to call ourselves, does not go after every railroad line that the Class I's abandon. We are business people. We are as much a business people as the Class I's are, and not every line deserves to be saved.

So, with that in mind, let me get to the heart of the subject which is "What are the Maintenance of Way Programs for Short Line Carriers"? Well, you are going to find that we are not much different than you folks are. Our organization is smaller and our funding is smaller, but in essence, railroad track is railroad track. And we can't cut it any other way than you do. It is still four feet eight and a half inches, and it is still laid on ties. The only difference is that if you come from the background that I come from, where I have bought lines now from three carriers, I have a Heinz 57 track standard. You can open up the Midwest or the L. B. Foster catalog, and you are looking at our inventory because that is the only way that I can do it.

So, what is our organization? Well, we have a president who reports to our board of directors. Our board of directors, of course, reports to our stockholders. That is all fine and good on the boiler plate. The actual reality is I have 101 route miles broken down into two divisions right now. Each division is about equal in distance and, at this point in time, I only have one track supervisor who covers that entire 101 route miles. I have a vacancy. Try to hire somebody out there right now who wants to be a track supervisor for a short line and it is not the easiest task that you'll come across. When we hire a track supervisor, we look for a person who can be extremely flexible, and I think that is another key word that we should address with the short line industry; we're flexible.

Indiana Hi-Rail is a union carrier. All of our people are represented by the United Transportation Union with the exception of management. I have 19 union employees who sit on a common roster and I mean a common roster. I can work them anywhere in 101 route miles, and the two bases that we have right now are Connersville and Evansville, Indiana. That is a driving distance of four hours. The basics is you could be a locomotive engineer for me on Monday and on Tuesday you could be driving spikes.

Now, that same key thing goes back to our management people. I'm the vice president, and that is a very nice title, but it means nothing. I'm also a track supervisor; I'm also a diesel mechanic when I have to be. I'm a marketing and sales person, and I do just about everything else that has to be done. So you say, where do these employees come from who are willing to do that? They come from the Class I railroads. They are the by-product of abandonments and so-called furloughs, and also the latest one, what we call the "buy-off." We have been able to pick up very good employees to operate our carrier, and now that we have gotten over the hurdles of having this joint common roster, the employees are actually, believe it or not, excited about the issue. We have engineers, now, who run tampers. We have maintenance of way people who have learned to switch boxcars and I have diesel mechanics who have now learned both sides of it, how to switch railroad cars and how to pound spikes. Again, I'll stem back and tell you that we are a business and, therefore, everything that we do has a cost to it. On our union scale, and I am not going into our agreement, our men operate and get paid 75 percent of the national scale. There are no arbitraries. We run with two man train crews and, again, everybody on there is open to work for the section department, with varying degrees of expertise. And where do we get that expertise? We try to hire guys away from you who already have it, that you expended your funds on to teach them how to do this work and we also rely upon the Railway Education Bureau for a great many of correspondence courses. Going back now to the organization, we have a track supervisor who is in charge of the track and makes sure that everything gets done. He reports to me and we tie it altogether. I want to talk a little bit about what exactly takes place in our planning department or how we do our maintenance of way planning. I don't think you are going to find us any different at this point than yourself. The first thing that we do is identify the problems and, believe you me, when you have bought branch lines from Class I railroads that have had deferred maintenance for the last ten years, you've got problems. Our annual budget normalized right now for our branch lines is about $4,000 a route mile. That's normalized. The last four years we have actually spent upwards of $8,000 to $10,000 per route mile. Now that is a drop in the bucket compared to what Class I's spend for a route mile, but if you think back about the branch lines that are under your particular jurisdiction, you probably didn't spend $4,000 a mile on them and I think it shows when we get out there to purchase them from you.

We identify these problems in staff meetings first. We call in our operations people. We do have division managers at both locations. We also have maintenance of equipment people at both locations. We call these people together twice monthly. We discuss where the problems are, identify them in house and we identify them out of the house through the FRA. We are naturally under their jurisdiction as well as you are, and also under the different state agencies. We then also go out on what we call on site inspections. And we listen to our train crews tell us where their problems are. We also listen to the equipment people telling us where the wheels are wearing out under the locomotives. We take all these problems in, and make a list, and find out where these various locations are. Then we try to match those problems up to some funding.

It is not an unlimited kitty. As a matter of fact, we have less resources to go on than the Class I's do. But nevertheless, we still take these in and we list possible locations, and this is where one of my main functions comes in. This year alone, I have been able to locate about $800,000 for our company from external funds. These funds are FRA dollars left over in a couple states. There are also some in-state funding grants that were still available and we have also located some Department of Commerce funds in one state. In addition to that, we take our normalized budget that our company is able to expend. Right now, out of our total operating budget, approximately 28 percent of that total budget goes to maintenance of way. Now when I say maintenance of way, I include everything. That includes the B&B and the track structure itself. It also includes our budget for signals. Again, these are branch lines; the only signals that I have to maintain are those of the interlockings and the crossing signals that I inherited from the other carriers. Believe you me, one of the first things that I do on some of these branch lines is go in and file petitions to get rid of crossing flashers at dead areas.

Many of the lines we have acquired were at one time mainline railroad segments, and now they go nowhere. I am trapped with signals at interchange points where my trains are practically stopped all the time anyway. So one of the first moves we make is to clean up and get rid of the excess dollar items that we do not need. The last choice that we use for funding, contrary to some popular belief, is the shippers. Indiana Hi-Rail may be the exception to a lot of short lines and let me make another point. We don't like to be called a short line. There is a negative cloud that hangs over the top of the word "short line". A lot of people remember some of these big carriers who milked the Class I carriers of all the interline accounts. We are the reverse of that. We are a switching and terminal carrier. We don't hold anyone's interline fund. The Class I's pay me at the end of the month for the cars that I have brought them. And I would like to add one more point, Indiana Hi-Rail doesn't operate a line anywhere where we only have one connection. Contrary to popular belief, the Class I's do not always look out for your best interest; therefore, you have to protect yourself. The last thing I want to do is interchange with one Class I. He will not have my best interest at heart. So I use two Class I's or three, or as many as I can get and play them against each other.

Once we have identified our projects we prioritize them. And that is probably not much different from what the Class I's do. So you say, what does a short line have to prioritize? After all, you only go slowly, so what's the big problem there? Well, we have, indeed, what we call mainlines where we do move heavier traffic at some locations than we do others. We put those at the top of the list. Then we look at one other thing that we consider most important to us and that is hazardous materials. Indiana Hi-Rail moves a lot of hazardous materials. Approximately 25 percent of our traffic is "hazmats", and if we can talk, interrupting one more time, about where some of the costs are coming in to operate railroads today, I shiver every time I see the Rail Cost Recovery Tariff come out because in the last year or so, the Class I railroads who turn in these numbers to the ICC have been experiencing lower costs. And again, as it was noted this morning, a lot of that is due to diesel fuel expenses going down. Diesel fuel is one of my minor costs. My two major lines on the expense side of the budget are labor, even at 75 percent of the national scale, and insurance. And let me tell you that in the last several years, insurance has certainly taken a big chunk out of everything. Our rate increases are tied directly to the national tariff. So we consider these hazardous materials as a priority. And we consider the tonnage that we are moving over the lines. Then we ask operations about crew delays. After all, labor is a big factor even when you are running a two man crew. Where are we losing time? Then we look back on derailment histories. And I might add that the reason I am your guest speaker today for short lines instead of the track supervisor for Indiana Hi-Rail is that he has been camped out for the last three days at what is considered a major derailment on our railroad. The good news is that they cleaned it up this morning.

We also have to go back to check where the funding is available. After all the State of Illinois won't let me spend their money in the State of Indiana and vice versa. Then I have to look at what our weather conditions are going to be for the work season. There is a four hour drive between Connersville and Evansville, but I can guarantee you that my work season in Evansville is a lot longer in the year. And then where is my equipment? Yes, we do own equipment, we don't lease it, although that is another way for us to do it. We buy what we consider important equipment, and where do we buy it? We buy it from you guys. After you rebuild it and decide it is no longer the latest technology, I'll take it from you. And then we have to consider, where do supplies and materials come from? Again, I have to play all the vendors against each other. I don't have that great a supply. I can't call the old division up and say "what have you got down there you can spare and send us?" It is all in one location. So after we do all this, we match the funds to it. And then we bring in what we consider our wish list. Hi-Rail does have flexibility, but we're not that flexible. I have a budget-minded financial officer who is the expert on the tax laws and the expert on how the depreciation will work, and he is the only who also tells us where our priorities should be.

Once I have done all that, I need to schedule these projects and get them implemented and this is an on-going thing. As a matter of fact, we are already planning now for next year and we will be planning for two years out. I'm sure most of the Class I's have planned further out than that and rightfully so. You should. We implement these projects with our people. We estimate what our cost is going to be to install this crosstie versus for what a contractor can do it. And I can tell you, this year all of our crossties, with the exception of emergency ties, are being put in by contractors. And you ask, "Well, what about the union issue"? That is not an issue with the union. Our contract says whatever cost is less is what will happen. Now if the employees voluntarily come to me and want to take a price cut on their wages to put those ties in, I would not stand in their way. But when you run a slim ship, as we call it, that is not a major problem, because all of our men are working this year. We did not hire any additional ones when it came down to fill the gap.

So we are not much different from anybody else. We schedule the work trains to distribute the material once we have received it from our vendors. We schedule our foremen, and our operators, and the equipment down to these different projects and put this stuff in. We give them time frames and constraints. We set goals in production. If we don't meet those goals of production we call people in on the carpet, and we still strive to get it. If it becomes worse than that, we pull the plug on it and we hire a contractor. We will get it done within the budget.

Now all during this nice, neat planning, of course, (you all have experienced the same thing) highway departments from the various states mail you these contracts and they say "you will do this because it is good for all of us". Well, we get stuck with those and we do them. We put in rubber grade crossings. Incidentally, Indiana Hi-Rail is not to be confused with the Hi Rail Rubber Company, and please don't call me for hi-rail wheels. I wish I could find some myself.

Once we have done all this and scheduled it out, we coordinate it with our transportation and our equipment departments to make sure that we keep the trains moving. It is kind of a Catch 22 cycle in railroading, as you all know. We don't have good tracks to run our trains over. That means we derail and get crew delays. At the same time, if we are doing this track work, we have to keep the tracks open because we have to serve the customers. If we don't serve the customers, there is no need to have the track. Once again, is that vicious Catch 22. Then we come back and we monitor the life cycle of these projects. We get our normalized maintenance. We figure the life expectancy of our crossties to be approximately 15 to 20 years even under our conditions, which is light tonnage, and you say "Well, that doesn't seem like much." Well, when you consider that 60 percent of the ties that I lay are relays there is another good reason why every abandoned line should not be salvaged for operational purposes. I had some really good crossties come out of some Conrail and Chessie lines here the last year and a half. They seem to retie them and then abandon them, and these ties come out and they are not that bad. It's really a good deal. The other percentage of the ties that we lay are six by eight grades and seven by nine grades and some of the latest grades that we have bought have been rejects from the other railroads. Again, this has brought our cost down and we are still getting a good tie. And of course I'm new to this business, but all my vendors tell me that if I buy from this guy, his ties are no good, his ties will be powder in five years. And if I buy from the other guy, then the guy who has the ties that powder in five years tell me, " Well you're not getting a good deal, they won't last any longer." So somebody is lying. We have crossties on our railroad that still look good that were laid in the 1940's. And that is rare.

So you say, that's fine and dandy and Hi Rail is a nice short line or switching and terminal carrier, so where in the future are these short lines going? I've given you a synopsis of our planning and I don't think you will find us any different. Again, our key word is flexibility.

I don't want you to look at the short lines out there in your territory as an enemy, as a cancer or as the guys who take your jobs away from you. That's the last thing we are there to do. But if there is a void, we are there to fill it. And if there is traffic to move, we want to move it. The thing that I want to stress with you is that we can be your greatest partner out there in the field, and this has happened many times at our present locations, in particular with roadmasters on these other railroads. We respond rather quickly. Our managers in the field do not have to call corporate headquarters to make decisions that won't harm the companies' operation. I can cite an example — we've bailed the Norfolk and Western Railway out a couple of times and they have bailed us out a couple of times. One of the prime examples that I can think of offhand was a couple of winters ago. The N&W had their local coming down to make our interchange and their crew stalled in a snowdrift. Now I had no crews on duty on my railroad, but they were only two miles from us. Their roadmaster came to my office and said "Can you help me out?" Well, we did. We responded within 20 minutes and had his train out of the snowdrift. Now that is one way of scoring some points. But it is also a backwash, because I'll be on the telephone to him shortly thereafter saying we have a derailment and we can't pick it up. How about bringing down your nice hoist system on that beautiful truck of yours and helping me out? And we sign the agreement, and pay their bill, and they pay our bill and everything is working rather well. So one of the things that I want to reiterate is that we are not your enemy. We can be a good partner to you out there, and the key word, again, is "flexibility".

I talked for Hi-Rail, but I hope I talked for the other short lines too. We are business people and we are a railroad in an era of changing transportation. There is, indeed, a place for the short line railroad out there and you are going to see more and more of them. The big railroads are getting away from rationalizing the lines that are losers; they are rationalizing market areas now. They have analyzed it; it is not down to we are losing money per track mile. It is down to we are losing money moving that commodity. That is not a commodity that we want. That's where Hi-Rail comes in. Analyzing the thing out, it may not be a commodity that the Seaboard wants, but it may, indeed, be one that Conrail wants and if you have an interchange at both points then this is the line that should be saved.

I want to talk a little bit about what our problems are as short line carriers. Our problems aren't always the Class I railroads. We don't see you as a problem — sometimes we see you as a hindrance, but not as a problem. One of our biggest problems is with the short lines that are merging into what we call regional carriers, acquiring several lines from different carriers. Again, we get into the Heinz 57. We have track standard problems. I operate a railroad system that has anywhere from 75 pound rail to 132 pound, and one of the shocking pieces of rail that we had was a 90 pound Dudley that no one had ever heard of. Ford Motor Company owns it. They wanted to relay it at one time and the only place we could find any of it was in Boston, Massachusetts. This is just one of the various problems that we have. That rail has since been replaced with 105 Dudley, which is a little more available in the area that we are talking about. We also tend not to have the bucks to throw at the projects such as the Class I's. I always like to walk behind where Class I's have graded ties for renewals on line, because it seems that whoever walks that line was probably given the instruction, you kick out every other tie or you replace two out of every three. We walk these lines and we look at this grading and we think, "Man, it must be nice," because you are kicking out ties that have a lot of life left in them for a railroad. When I send my track supervisor or my foreman out to walk a line and I walk behind him later on to check him every once in a while, I can guarantee that we are very selective on what ties come out of the line. We have even gotten to the point now and its not innovative, I'm sure, that we change tie spacing. We've got three rotten ties; we'll take all three out of there so we can still surface the line, and stick two in their place. Again, I am talking about light density branch lines.

Then we come to the next problem that we have and that is capital budget for machinery. My machinery works all the time. I know as you Class I's get bigger, you get this advantage of being able to do some work in the northern part of the country during the summer months and then shift machinery to the southern parts of the states for the winter months and extend the usefulness of the machinery. We aren't much different from that. Our machinery works the entire work season; however long or short it is, and then it goes into the shops in the winter time for maintenance. But we can't always afford all that deluxe machinery. I do have, I'm not proud of it but I'll admit, we have one of twelve dinosaurs in the country. I don't know if any of you remember those dudes — they came out about three years ago and were going to revolutionize the track industry because this backhoe had all these nice hi-rail wheels on it and a nice tie-inserting bucket. Well, we have one of those dinosaurs and, needless to say, they made twelve of them and made no more. The cost of doing business is another one of our constraints that I mentioned earlier and is one of our problem areas. We do have several advantages over the Class I's, but we also have some disadvantages. The main disadvantage is that you guys have the mechanized machinery and the technology in hand. We are developing that. I'm not saying that you are going to see mechanized gangs all over Indiana Hi-Rail someday, but I'm most impressed at this point; we're working on this now. You can do your costing on computers relatively quickly for projects. We are developing that currently in-house. We are a computerized railroad carrier, but have not developed our maintenance of way costing on the computer. We still do a lot by hand calculation which slows us down somewhat, but that is a problem that we are overcoming.

The future of the short lines as I see it, and the industry as a whole, is there are going to be more of us. There are going to be some good ones. Indiana Hi-Rail, although I am biased, is certainly a good one. We are going to get bigger. We are probably tapping into some of your territories. We receive rationalization programs from every railroad in the country. Then again we have to define marketing areas. We are not coming out of the midwest. But you have to know that the carriers you are working for are indeed shutting off unprofitable market centers. Those market centers can be profitable for me if I can give the traffic to another carrier. So we are coming to an age when there is going to be more and more of us to work with. I would like to just reiterate the fact that we are not your enemy and we are not a cancer. We are your partners out there in the industry and we can be very flexible. I think together we can work and have a healthy railroad industry within the evolving transportation industry as a whole.

Thank you, ladies and gentlemen. If there are any questions, I'll be glad to answer them although I don't have very many answers.

President Bessey: In case you weren't aware of it before listening to these two gentlemen speak this morning, the railroad industry is changing and I'm optimistic enough to feel that the end result of these changes are all going to be positive and it is nice to be a part of it.

This joint session is coming to a close. We are now going to break up. The Roadmasters will have a ten minute break. The B&B Association will reconvene in five minutes on the sixth floor in the Adams Room and we have two very good subjects this morning and a complete program this afternoon. This joint session now stands adjourned.

TUESDAY MORNING

10:00 a.m.

President Bessey: The second session of the 91st Conference is now in session. We had very good participation from the audience yesterday and I think that is great and that is what we want. It adds a lot to the particular subject and so please continue to do that. Also, we ask that you do use the two center microphones, they are both turned on, because we are recording the proceedings and all the comments, questions and so forth will appear in the Proceedings. So use the center microphones because our recorder picks up the sound off the speakers. If you didn't hear the attendance figures that were given this morning, Roadmasters, 182; B&B, 66, Associates, 184; Guests, 52 and I believe there are 55 ladies. So, this a slightly smaller group than what we had in 1984 and there are a lot of reasons for that. But we still have a good conference. We have a lot of good material to present today and tomorrow. Jim Williams has been passing out those blue cards and there are four special subjects for next year, and you can't get out of the room unless you fill out a card! So please do that. In the last few years we have had a falling off of people getting involved in the special subjects. You all have done some things on your railroads and if one of the things you have done is one of these four topics, let us know what you did and share with everyone. So let's make this a banner year and fill out those blue cards and get involved in **your** association. Now, that the commercial is over with, I'll call on Mr. Lewis, chairman of the special features, to introduce our next guest.

Mr. Lewis: Thank you, President Bessey. I would like to now introduce Mr. Rick Dunlop who will make the next presentation on energy retrofit of the Union Pacific's Omaha shops.

Mr. Dunlop comes to us from the Manville Corporation. He is the national manager of Manville's Retrofit Construction Services Group. Rick is responsible for the design, engineering and installation of custom insulation systems to retrofit large commercial and industrial buildings. He is presently very active working to bring both new insulation products and application techniques into the market. These products are being designed in a practical manner to help reduce the large heating and cooling expense in the commercial and industrial building sector.

Today Rick will specifically discuss the technological advancements made by the fiberglass manufacturers, the products which are available, how these products were designed and installed in 15 different types of buildings at the Union Pacific Omaha Shops complex and what the energy savings results have been. I think you will find his talk both enlightening and enjoyable. Please welcome Rick Dunlop.

ENERGY RETROFIT OF UNION PACIFIC'S OMAHA SHOPS

Rick Dunlop

National Manager
Manville Corporation

Good morning. I think I will start out by saying that first of all these slides that you are going to see today are actual before and after shots of the Union Pacific Omaha shops complex. It should stimulate a few questions. If you can hold those questions to the very end we'll have a few minutes after this presentation to address those questions and if there are more questions than we have time for I'll be here after the break. Also one other announcement, in the back there is a box sitting on the table to the left of the door, all this stuff that you will see today is printed literature, there are reprints from major publications and if you are interested in getting that information, just throw your business card in the box and we will handle it from there.

Manville Commercial Construction Services is the contractor arm of Manville Sales Corporation. It was established in the very early 1980's for one reason. Manville manufactures so many different types of products and everybody here is aware of the current situations with liabilities and Manville decided that the best approach would be to manufacture those materials and also install those materials to limit liability when, in fact, your product has misapplied. So, hence, Manville Construction Services. Basically, how we got into this business was by doing a major survey with all the major plant engineering-type publications, such as Plant Engineering, Engineers Digest and those types of publications, with a major point of trying to figure out exactly how much work did exist out there in the commercial and heavy industrial building environment. What we came up with was between 100 to 150 billion square feet of manufacturing and old warehouse space that was built prior to the first energy crises of the early 1970's. The pictures that you are going to see here today are of the Union Pacific's Omaha shops complex which was built at the turn of the century. We have been working on a regular basis with the railroad industry and in particular for the last two years. It is amazing to me because I get to see so many different types of buildings. It is almost as if one architect designed everything for the entire railroad industry because every building almost looks identical. So you will see buildings here that look exactly like your facilities, wherever they may be. Manville made the determination that there were so many old buildings out there it would be less costly to go in and make those buildings energy-efficient than to demolish them and build a new building. The systems that you see here average in price anywhere from $1.34 to $1.75 a square foot installed. Typically, you will get a chance to see what some of those systems look like but the retrofit market is all the older buildings and this is a typical type of construction right here. This building is the steel car shop at Union Pacific Railroad. Now I want you to take a good look at it because I'm going to show you exactly what this looks like after it has been insulated as well. Primarily, you have an old steel truss; you can see the clutter on the floor; I'm sure that a lot of you have buildings that are very similar to that. The main objective in this type of building was to do this. No. 1, we wanted to enhance the over-all savings picture by turning around and reducing the volume of the air to be heated in the building. For instance, if we came in this room and there is an aisleway right down the middle of this building here or in the middle of this hall, if we put that barrier in between in the middle of it and insulated it, and when we heated this half next year it didn't heat that half, you would experience about 50 percent reduction in the total volume of air that is heated in this room. Hence, what that does is it eliminates 50 percent of air being heated and an additional 50 percent savings over and above, independent of the newest insulation systems in the building. So we knew if we could reduce the overall volume by basically lowering the ceilings we could enhance the payback picture. Also, cooling time gives us less business in this industry. We don't really see too many buildings that are cooled. Solar or heat gain, that just means in the summertime when it is so hot in some of the old shops, by putting up a thermal barrier inside the building, you don't get that heat in the building as well. And the last thing is noise transmissions, sound continuation, a lot of the old shops are very very noisy.

A reduction in cubic heating oil. If we came into this building and lowered the ceiling ten feet, that would give us approximately a 20 percent reduction in overall viable space that is heated in this room. We would experience again, an additional savings almost one for one, of approximately 20 percent. The overall reduction by the Union Pacific was approximately 12 percent. We call the systems in this particular environment Custom R Systems, because they are custom-designed and custom installed. This is one of the different methods of installing, you can see here a welder actually welding pins to the other side of the steel support structure. Those pins are placed about every 18 inches on center and what you do is you peel the insulation up into it, and when you peel the insulation up into it, you lock it in place with a lock washer. Those lock washers hold 400 pounds per square foot. So you can put as much as R 60 into the building and below, if need be. What we do is actually take a look at the economics involved. When it's your turnaround value or factoring with insulation, the higher the R value over a longer period of time you are going to be better, but what you are trying to do is to come up with an R value that is paying for itself in the fastest amount of time.

This is that steel car shop after the insulation system has been installed. What you see here are rolls of insulation four feet wide. They are custom manufactured and they are custom length, custom width, custom density and with custom facings. The reason for that is because every building is a little bit different. What you will see here is a placement of pins every 18 inches on the center to the other side of the support structure. The insulation ran perpendicular to that. For instance, one of the key things in the older buildings that you have to address is vapor migration. If I am talking a little different language here, really what you want to do is to preserve the integrity of the building. You want to make sure that you are not getting any type of vapor through the system so it can land on the steel up above it and turn around and become an incubator to rust. So you have to install vapor systems, continuous vapor barriers. What you see here are installation systems four feet wide but the facing on it was four feet seven inches wide. That means that there was a three and a half inch flange on either side of the material. By doing that when it was installed, we installed the next roll of insulation in direct abutment with those two flanges facing together down into the room and roll-tucked and stapled into the system to preserve that continuous vapor barrier. You can also see here that in a lot of these older buildings, most of them have fans and ventilator units all the way up at the other side of the roof deck.

In a clear storage area we have prefabricated ducts to make sure that we also preserve the integrity of the ventilation system inside the building. That was a later date cover, you can see all the holes in the middle of the system. That was just to show you what we had to do to bring that ventilation system down through the system so that we could maintain it. That is one system.

One of the things that I want to point out here is what additional value to these systems are. We as a company, along with the other manufacturers of these types of products, invested over 500 million dollars to come up with facings. These facings meet all the federal regulations on flame resistance. They have to or you can't install them inside the building. Equally important, they have 78 percent white reflectivity too.

This is called Building 10A and 10B. It is the machine and traction motor shop and is approximately 1,008 feet long. Here you can see the other side of the truss right above the crane. What we wanted to do was to eliminate all that unneeded, unused space. Let's be honest, when these buildings were built, they were built on specs, with all this vertical building that is no longer needed. You no longer need all that space up there. What we tried to do was to eliminate as much space as possible for a couple of different reasons. Number 1 to reduce the cubic heating volume and equally important to eliminate conductive load inside the building. Basically, I could show you through a graph mode what a conductive load really is. This is what that system looks like when it's fully installed. What you'll see is aircraft cable every two feet on center running the length of the building. Now, that is attached with something called a ratchet tightener. You can relate to this if you see the old warehouse and logging trucks going down the road with all the lumber strapped in. That strap is tightened with a ratchet tightener. The idea here is to put up something that will support a system that weighs what this weighs. Probably the most important part about that though is that as your building breathes, these are older buildings but they still breathe, and as they breathe they expand and contract, and as they expand and contract that aircraft cable wire, which is 49 strands intertwined, has a tendency to stretch which causes deflection in the building. It is only inches of deflection but I want to point out something here. There is exactly three inches from the top of the fly wheel to the other side of the insulation system so you can see if there is any deflection whatsoever that fly wheel will catch and will work the insulation system. So we built in a safety factor that any time over a five or ten year period when you start to experience deflection, all you have to do is go to the ratchet tighteners which are placed every two feet on center. This building is about 156 feet wide with about 75 or 80 ratchet tighteners. Tighten the ratchet and pull the system right up again. It might take you an hour to do that. So it is easy maintenance if anything like that would ever happen. But here we eliminated almost 18 percent total volume.

Here is what it looks like fully insulated. Again, the light reflectivity here is amazing. Just to give a little background on this, in 1983 I was making a presentation in Atlanta at the Sixth World Energy Engineering Conference and I met a fellow who was the manager of energy for the Union Pacific Railroad. He said "Rick, since the mid-1970's we have been trying to prove that insulation would work in our shops and just because the buildings are so high, and there are so many obstacles our payback was just too low and we just could not do it. We went to an outside engineering firm that cost literally thousands of dollars to find out how they could make the plant more efficient. The engineering firm came back and told us that the insulation wasn't viable but if we would change our steam-fired heating system that was very antiquated to radiant and direct gas fired heaters at a cost of approximately two million dollars, that they would have a savings. I just want a second opinion." So, I went out there in December around Christmas time and with the windchill factor it was 60 degrees below zero. We did a preliminary economic analysis of 28 buildings, 15 of which proved to meet their mandated return on investment requirements. You can see what we did in this particular building was reduce the volume of air about 15 percent. But a lot of the other factors are one it almost looks like a blanket inside the building so it generates warmth and it looks warm and it actually is, compared with 60 degrees below zero. The guys in this shop complex, and if there is anybody here from Omaha they can attest to this, you can walk through here in shirtsleeves now. The lighting is extremely high, but the projected savings for the entire complex was $427,000 which translated into an almost 4.75 year return on investment. We are going through the process right now of documenting that. We do that after every project to make sure that the savings came out to what was projected, and it looks very good at this point in time.

I want to mention something called elimination of conductive volume. This is extremely current. We haven't been able to prove exactly how important it is. They are doing studies at Drexel University in Philadelphia and it is by the Center for Insulation Technology. The reasoning is this: let me give you an example here, on a normal winter day in Chicago when the outside average temperature is 23 degrees Fahrenheit we are going to find out that if you went out on top of the roof, on the side walls and windows and put a thermometer there, you would experience 20 degrees Fahrenheit. If you come inside that building and put a thermometer on the other side of the roof bent or on the sidewalls you are going to find out that the temperature right there in that cold steel or cold metal or even wood, which is not as big a conductor, but it also does some of that, we are going to find the inside temperature to be about 30 degrees. The difference is only the inside air volume in the building. Now, if we are down on the floor trying to maintain 55 to 60 degrees inside that building, it is impossible to do. Thermo-dynamically it is impossible to do because hot air rises, hits that cold steel roof deck around the windows and it is called the heat-siphoning effect. It just gets siphoned right out of the building. Like a negative air pressure inside the building. It just sucks it all out. So here we are in this continuous cycle of trying to keep the building a certain temperature but it is just being sucked out. So the objective when you go into a building is to cover as much metal as possible. By doing that, as the hot air rises it now hits this thermo barrier and it starts what is called stratification. It starts to stratify on its own back down into the room because it has nowhere else to go. So by doing that, you have thermo short-circuited the interior condition space from the cold steel or cold concrete or cold wood. That is one of the objectives.

This is the fab shop. Now if you guys know your own fab shop, this is incredible. First of all we worked 24 hours a day at this shop complex. It was fully insulated. If they were working first and second shift in this particular building then we worked third shift. If they worked third shift then we worked first and second. They staff that with about 2,000 employees and we finished way ahead of schedule but with little interruption time with what they were doing. There is a lot of coordination that goes into a project like this, but in this particular building they were working third shift. They came out in the morning and all you saw was teeth and eyeballs because the fab shop is so dark they were working up on the ceiling and working on the walls and they were black when they came out in the morning. It was so dark inside the fab shop that when you walked in there it would take your eyes literally three to four minutes to adjust to be able to see anything around you. That's how bad it was. This is a picture of our guys, they are up at the ceiling line. Actually what they are doing is mechanically attaching fastening systems so we can install insulation. That's what it looks like once it is completed. Now this particular system is not real similar to what you have seen already. This one is attached right to the underside of the support structure at the roof deck. Elimination of cubic heating volume here may be about two or three percent, not much more. But you can see with the lights being located at the top part of the truss, we would have to lower the lights, we would have to do some other things inside the building that would prove somewhat too costly for UP to address at that point in time. So we installed them right at the roof deck. The big difference in there is an additional savings by lowering the cubic heating volume but not much else. If you can see the brightness in this facility now, it is like night and day. It is like walking into a building that has tons of windows and it doesn't have any. The light reflectivity is 79 percent and what that means is that it picks up 79 percent of all the available light inside the building, reflects it off the ceiling and shines it back down in. Now, Manville also has a company called Halopane Lighting and we also design and sell their systems. Now these facings were designed around the light reflectivity of all our glass present lighting systems so that the light would backwash off the insulation and come back down. Union Pacific chose not to retrofit their lighting system, but what they are evaluating right now is eliminating every other one of those lights. They just don't need as many lights now as they had before. Now what that means is that it puts them in a different peak demand power situation for their electricity and puts them in a different cost per kilowatt hour. Which is savings. Added value to the insulation system, over and above what the original projections really were.

This here is the paint shop. Now this is a similar system designed right to the underside of the roof deck. You can see the amount of obstacles that you have to work with when you are working inside a building like this. It takes an awful lot of coordination, but there really isn't any building that can't be insulated. You just have to design the way to seal it.

Now UP buildings had a lot of lunch and locker rooms, things like that. What we wanted to do here was to provide them with a little different look. There is a system out called Suspendar. And what Suspendar was originally designed to do was to provide a very sophisticated looking ceiling insulation system and be able to lower it as much as 30 feet off the roof deck of some of these older buildings so that we could basically reduce the cubic heating volume. That's where the concept came to reduce as much air as possible but yet to provide a system that had the same integrity of a continuous vapor barrier. So here we designed a system to fit right into the support structure. That is a before shot and that is an after shot. Which gives you an idea, it is a little bit different, they have the capability of going up to R 44 in these systems. The systems that you have seen so far have all been R 19 systems. This one here was an R 25 system and has the capability of going up to R 44. Also, it is a different facing. This is white polyproplene facing.

Let me give you just a little background on these facings. These facings are either a foil facing or polyproplene facing with a very thick kraft backing, and laminated between those two is a roll of nylon mesh. This is done strictly for tensile strength and durability. Working in these old manufacturing buildings, you have to make sure that your product is extremely strong. It has to be very abuse-resistant. When these systems go into place we guarantee the craftsmanship on everything that goes into the building. If there is ever a problem with it we will come back and repair it. We manufacture tapes also that are good for 40 degrees below zero before you would start to experience any delamination, but we tape those same facings as that we have right here. Anytime you have to cut into the system to put in a new lighting system or something else, you just use the tape and the tape fixes it so that you can maintain the integrity of the continuous vapor barrier.

I want to get into windows just a little bit because these old shop complexes usually have an awful lot of window space and that is strictly because they were designed for free lighting, free ventilation when we were paying five cents a gallon for oil. What we are losing now is heat and compared to what we are gaining from the lighting, there is no comparison. A study was done on all the windows at UP and they were losing 800 BTU's per square foot per hour out of the windows. It may sound like gibberish to you but basically when we install an R 19 insulation system over a portion of the window and I'll show you what that looks like, this a before shot. This is one building with an after shot, going from 800 BTU's per every square foot for hour lost to 80 BTU's per square foot per hour lost. So you can see the dramatic turnaround. Windows have no R value, so they become probably one of the biggest areas inside of the building that will loose BTU's. That needs to be addressed. We used the white polypropolene finish. There is no difference in cost, there is no difference in R value, it is just a white look. But as you can see, we covered three-quarters of the windows and in some places we covered almost all the windows. In this particular building we wanted to maintain some visionary glass so that the guys working on the floor could look out and see what it was like outside. In any building, the heat loss is in the upper one third portion of the building so what you want to do is address all the problem areas first and then start to scale back and we thought it was more important to the guys to be able to look out the window and not feel caged in, rather than cover all the windows for that little bit of added value. Here is a close up look of it.

Now as you can see there is a row of pins right at the top, there is a row of pins right in the middle and there is a row of pins right at the bottom. That is four feet wide, R 19 insulation, also you can get a better look at some of the seams, you can't see it very well but, it is very important that you maintain the integrity because if you get vapor going through that system and landing on the metal sash and blinds behind it it becomes an incubator for us. So, there are a lot of things to consider. People think that maybe I can go down the street and get one of the local guys that puts home insulation in to do this for us, but the best advice that I can give you is to call a professional because they are experienced in the needs to be addressed. They have already ripped out numerous insulation systems in facilities like GM's pontiac motor division because that was installed by the workers when they were very slow and they wanted to do these kinds of things but they just didn't have the expertise, so be careful about doing it with somebody that hasn't done it before.

Now this isn't a unique building. UP has buildings like this as do most of you. What I want to do is show you how you can address the window situation from the outside as well as the inside. That is the reason for this slide. As you can see, this particular company here does all the packaging for Squibb, Johnson & Johnson and others. They have tremendous problems with the windows, not only from an energy standpoint but also from weatherization. They were getting rain inside the windows and it was destroying the packaging. We used a closed cell insulation board and a plastering technique. This was a joint venture between Manville and Dow Chemical and we turned around and provided them with that type of look there. This is a little bit more expensive but the difference here is that you get brand new looking building. The R value is about an R 8, so you get a significant amount of R value going from R .26 to an R 8 so it is a dramatic savings. What you do, is you address the problems of your building and stop the vapor coming in and you get a brand new look.

Just briefly, almost everywhere I go, people say "Wait a second", because these types of systems are a new approach to energy management. People say, "Well you know, if Manville is one of the world's largest manufacturers of build-up roofing", which we are, "how come you guys are doing things like this on buildings?" Well, you guys will appreciate this from an engineering background, there are so many things that you can do inside the building that you really can't do outside the building and I will just go through it briefly. You can get up to an R 20 on the wall outside. The older buildings aren't designed to take really anything more than an inch or maybe two inches of built-up roofing insulation because you have to turn around and make sure that it is sloped right and so on. But you can get as high as an R 20, which is about five or six inches. In the interior systems you can go all the way up to R 60. The cost of that built-up roof is anywhere from

$3.75 to $4.50 a square foot for that escalation, as opposed to $1.50 to $2.50 a square foot for an R 24. So, what you are looking at here is double the R value at half the cost.

Maintenance costs, as everyone is aware, is about 50 cents a square foot on any type of built-up working systems. If you have experienced polymer systems, all right, polyurethanes and others that are about 45 cents a square foot, maybe that's because of the problems with those. The problem with fiberglass, once it is installed it is hidden from the weather so you really don't have any problems with it. They are also designed to be removed. If there are any roof plates in the portion that you experience a problem with, they can be removed and once they are dried out and reinstalled you have the exact same R value. Those factors are all designed into the system. Built-up roof is about 7 to 15 years to pay for itself and it is two to five years for other fiberglass.

One of the biggest things is the obvious enhancement of a tiered facility by adding light to it. What that basically means is that you pick up any existing light in the building and shine it right up the ceiling system. Life expectancy of a good built-up roof is about 15 years. We have programs with our built-up roofing people that are 20 years, guaranteed, but on the other side we have had systems installed for over 40 years, now not in major plants because we just started doing that about four years ago, but inside of light commercial structures and they are still performing.

Briefly, energy conservation and sound continuation are reasons to address the plant. It reduces the volume of building space to be heated and that is extremely important. It enhances builders' studies if you were ever to sell it and not only does it add value to it but it enhances the aesthetics, lighting requirements are cut dramatically, it is maintenance free and you get a very, very strong return on investment.

That is really it as far as this part of the program goes. I think the key to any program is really to identify the problem. We were infants in this business trying to identify problems that existed in some of the major manufacturing facilities, and the obvious problem was how much insulation is already there in the form of a built-up roof or whatever. So you can't spend the money to travel to all these places, and then get there and find out that you already have fiberglass insulation or something like this and you can give them a payback in the next 20 years. It doesn't make much sense. So what we did, and this is being utilized by the people at the Union Pacific, is we developed a preliminary economic analysis program. Basically, it is 20 questions, and there is a front part of this that describes exactly how to answer these 20 questions and they are basics. What is your square footage? How much insulation? What do you use to heat the building? How many hours do you run it? What is the temperature you are trying to maintain? Just very basic questions. Well, when this is filled out and sent back to our office we plug these in the computers in our Chicago office and in our office in Philadelphia and we pump out two things. One, with this information we are able to project what the preliminary construction costs would be; and two, we are able to tell what the economics may be in terms of payback. That is real important because there is a question here that says, "What is your corporate mandate on return on investment?" and then we generate these reports. We don't charge anything for this because this is really a qualifier for you. Why spend your time on a building that is really no good, and it is a qualifier for us also. We'll just send these back out in a nice report and it gives you the information that you need to know. If it is viable, then you take it to the next step, which is an energy-type audit, a formal engineering analysis. But that is what is offered and UP is doing that on all their buildings. I think it is real important because if it is there, take a look at it; if not don't worry about it. Any information that you require for your files is available to you as well.

You will probably see certain ads, like this particular ad, that shows up in Modern Railroads and some of the other magazines, and it just promotes the preliminary economic analysis. There is one other thing I would like to add, getting back to the reason for UP's initial energy audit was to get a second opinion because they had priced down a brand new heating system, at $2,000,000 by the time our insulation system was installed, with the 12 percent reduction in cubic heating volume, and the added R value to the building, what happened was that that system went from $2,000,000 to $1,600,000, a $400,000 savings because it didn't use many heaters, didn't use many

BTU's. So there are a lot of other advantages to that. Does anybody have any questions?

Mr. Lewis: Rick, how is UP going to go into a building where they have building truss? Do they have catwalks up in there for visual inspection?

Mr. Dunlop: Well, these systems are all designed that where there is an access point, where you have a steam trap or something above the system, you have to access that. Any points that you want to have access to, that is all designed right into the system and there is no extra cost for that and we do that as a rule. So anybody can go up into that system and check anything they would like, year after year. But that is designed right into the initial design of the system. Does that answer your question, Don?

Mr. Lewis: Yes.

Member: How do you know if there is a leak in the roofing system?

Mr. Dunlop: Union Pacific had a roofing program where they went in and repaired the leaks that they had which is always a good idea. Now you can tell with these insulation systems, when a roof leaks and water comes into the building it doesn't lay on the fiberglass. The fiberglass is all fibers, and the water leaks right through the fibers and it lays on the facing. When it lays on the facing and you have a significant amount of water, a little bit of water you don't even recognize, the fact is that there is space up there and it is going to evaporate anyway. But if you have a significant amount of water coming in the building it lays on the facing and creates a bubble and that is how you identify the seam points inside of the roofing system itself. You address it one of two ways. You can either tape that part of the system down, which is relatively simple and I would recommend that a professional do it for your maintenance people for the first time so they understand exactly how to do it. But if you didn't want to call somebody in on the problem, you can go up to it, take a real sharp knife, if you don't, it won't cut the facing, and you can make one slit right in the facing, let the water pour out, leave the slit open for 48 hours to dry. Once it is dry, what you do is you tape the facing with the tape that we talked about that is the same as the facing and you cover it well. Insulation is a product that once wet it loses its R value, once dry it regains its full R value.

Member: Did you provide for adequate ventilation above the layers of insulation?

Mr. Dunlop: Yes, we did. We built that right into the system. We feel that it is important to make sure that the system is ventilated. We didn't have to do it here. You may have buildings that have sprinkler systems. Some of UP's facilities did. In those situations you address it one of two ways. One, if you try to reduce the amount of air in the building to be heated, then you lower the system below the sprinkler system. You can do that. That is not a major problem. But what you want to do is to maintain that sprinkler system so it doesn't freeze up. That is a wet system not a dry system, which most of them are. So what you do is you address that problem at that point in time in one of two ways and we have done it both ways. You either build access points into the system, with louvers and thermometers up above the plant area and as it hits 40 degrees, the louvers open up and fill the cavity with enough air to maintain it about 40 degrees so that you don't have your sprinklers to freeze up. That will bring certain heads down into the room. That is one way.

The second way is to turn around and wrap it tightly with a coil. The coils come in many lengths and that coil gets plugged into the wall and that maintains 48 degrees at all times. You should check that before every winter and you should check it one time during the winter to make sure that it is functioning properly. The third thing is to have a sprinkler man come in and address the water in the sprinklers. We found in all cases that that is the mostly costly way to do it. The one thing you really have to consider though is that by reducing the volume of air in that building and below that it is significantly better for you over a period of time, than to just say to heck with the sprinklers and go over the top of it. If you could do that, you should address that. At Union Pacific we just put the system up above it. It would probably be better off in the long run, say ten years from now if they were lowered. But we were looking for immediate results.

Member: Did you insulate the ceiling?

Mr. Dunlop: No, we didn't at this particular facility. I'm sorry we didn't. We do. OSHA has us go into certain buildings and insulate them. OSHA dictates that something be done and we have done a number of buildings strictly with that particular problem. We have a program at our research headquarters in Denver and we take a reading and the parameters are, what is the square footage of the room? What is the construction? Is it metal? Concrete? Wood? What is the square footage of the ceiling area and the wall area? What type of objects are in the building? Is it steel machinery? What is the floor made of? And we get a decibel reading inside the building and then we run it through all the testing processes by adding different insulation systems to the building. Let's take a building that has an OSHA problem, 80 DB's. We can lower that to about 72 DB's, 71 DB's, but that doesn't sound all that dramatic until you take a look at the perceived noise level. The perceived noise level averages about 50 percent reduction, which is traumatic. Oftentimes we will do projects strictly with that in mind and not any consideration for energy savings.

We did introduce a new product at UP and this might be of some interest here. It is called "White R". You know we have R after every one of the products. But basically, White R is a cottonness white fiberglass. You can go into the market place and you can see Jack Nicklaus shilling yellow fiberglass and the Pink Panther with pink fiberglass, but this is white cottonness fiberglass. The value is that it transmits light itself. We install it over windows and we get as much as 28 percent transmission of light. So it stops all that heat going out of the building. But it also allows for free lighting into the building. I wouldn't recommend using it in some of your shops strictly because it is white cottonness fiberglass and it will pick up your dirt in certain buildings a lot faster. Not from the inside but when you first initially install it over the windows it will pick up the dirt from the metal sashes and blinds. We can use it in a lot of buildings though.

Are there any other questions? I certainly have enjoyed being here and sharing this project with you. We have been going out to a number of the different railroads and as I alluded to earlier, they are all identical. It looks like one architect designed it and everyone just copied it. If you have some specific application questions or any questions at all, Lee and I will be in the back of the room during break. If you want any information on what we have done at UP for your files or if you are interested in any of those preliminary economics you can just throw your business card in the box at the back and we'll mail them to you tomorrow. I certainly appreciate your attention. Thank you very much.

President Bessey: The railroad organizations are very close knit organizations and we share all these things with each other. That's why we build all the buildings the same! I think that this is a very good subject; an extremely important subject to all of us. It brings to mind that back many years ago on AREA Committee 6, we would do a diesel house spec together on how to build a diesel house about 10 years after diesels came into the picture. We did a subject on spot cars about 10 years after spot car systems came out. Well, the energy crunch in 1972 was 14 years ago and I suppose we have a few buildings on our railroads that still should be looked at so this is a very good subject and should give us something to think about. The next item on our program is a special subject. Here to make the introduction is Mark Walbrun.

Mr. Walbrun: Our next subject is Special Subject No. 4, The Proper Use and Selection of Hand Tools. Tom Waltemath, who is B&B Supvervisor with the Union Pacific Railroad and has had prior experience as a mechanical contractor in California and Oregon, is here to enlighten us on the practices of his railroad and other information we can apply to our practices. Tom.

SPECIAL SUBJECT NO. 4

Disadvantages/Advantages of Hydraulic/Pneumatic/Electric Tools

Chairman: T. F. Waltemath, B&B Supv., UP, N. Platte, NE

Selection, Care and Maintenance of Tools

The subject of selection, care and use of hydraulic, pneumatic and electric tools covers a broad range of information. In the following presentation I will attempt to supply you with the information you will need to evaluate a job and select the proper tool to do the job safely and efficiently. Providing you maintain this tool properly, it will give you years of troublefree service through proper lubrication and storage.

The Right Tool for the Job

There is no magic formula to determine what tool to use to accomplish the project assigned. By considering a few facts you, as a supervisor or officer, can determine what tool will fit your needs the best.

1. What is the job?
    a. Building construction
    b. Building repairs or renovation
    c. Bridge repairs (wood, steel)
    d. Crossing rehabilitation
    e. Sign installation
    f. Concrete forms
    g. Demolition
2. Power Source
    a. Electricity
    b. Generator
    c. Air compressor
    d. Gasoline powered
    f. Hydraulic
3. Environmental Conditions
    a. Inside
    b. Outside
    c. Water or moisture
4. Job Site
    a. Level ground
    b. Rough terrain
    c. Elevation (scaffolding, high reach)
    d. Accessibility for trucks and equipment
    e. Track time

Now that you have determined the above factors, let us go on. You have decided on the tool for your building project. There is electricity available and the gang will be working inside and outside on level ground, with some scaffold work involved. The weather is clear. Now, do you need a light, medium or heavy duty tool? Is it versatile and can it be utilized for other projects? What safety features are built into the tool; i.e., guards, shields. Will ear or foot protection be required? Is the construction of the tool durable? What about service or repairs? Can a standard repair kit be purchased with it for emergency field repairs, such as gaskets, "O" rings, shear pins?

The weight of a tool affects its efficiency a great deal. Generally speaking, a tool for continuous use over long periods of time that weighs over seven pounds but less than 15 pounds should be equipped to be handled with both hands. Tools for intermittent use should not weigh more than 20 pounds and any tool weighing over 20 pounds should be considered for two-man operation. Otherwise, it probably will not be used or if it is used by one man, the efficiency will be lost by fatigue. Electric tools generally meet these weight requirements. In the last few years, weights of electric tools have been decreased by almost 50 percent in some cases.

All the above should be taken into consideration to purchase the "right tool for the job". To get the most for your tool dollar, it does not stop with the purchase. Unless a tool is maintained and cared for, your investment in a good tool is lost, as well as man hours in downtime, productivity, and in many cases, personal injuries.

Hydraulic Tools

Bridge repairs and building maintenance have come a long way thanks to the innovation of the modern hydraulic jacking systems available today. I am sure there are those among us who have spent many hours and much elbow grease on the handle end of a ratchet or screw jack. With the introduction of a wide variety of tonnage capacities, stroke variations, double or single action cylinders and heights, a B&B gang can do in hours what previously took days to accomplish.

You also have a choice of jacks specifically designed for a ballast deck bridge or open deck, as well as hydraulically powered chain saw, hack saw and guide which adapts directly to a channel guide mounted on jack channels. These jacks can be used in any position, with remote operation by either manual, gasoline, air or electrically powered hydraulic pumps, either at the application or with hoses a distance away. Being of heavy-duty construction and durable, these jacks, as with any tool, need maintenance and care. Transportation and storing in a container will aid to keep them clean and prevent damage to pump and hoses. Prior to and after each usage, be sure to check hoses, fittings, gauges and pump for damage. If a hydraulic leak develops, make sure you check the manufacturer's operation manual before adding oil. Addition of an improper oil can cause serious damage to the jack. With proper care and maintenance, this tool will provide you with years of dependable, versatile and safe service. A wide variety of tools are available to complement your hydraulic power unit.

Pneumatic Tools

A pneumatic tool is a high speed machine containing a variety of precision parts which are assembled in a suitable housing. The objective is portability, regardless of whether the tool is a spike driver, concrete breaker, chipper, grinder, etc. Equally as important as portability is the extent to which the modern air-powered tool takes the place of manual labor, at the same time doing the job better and faster. The operating principle makes use of the energy which results from the expansion of compressed air. Depending on the type of tool, this air power may subject the working end to percussion, constant pressure, rotation, or a combination of these operations.

Broadly speaking, there are two basic types of pneumatic tools — those which involve reciprocating motion, and those of the rotary type.

Reciprocating Air Tools

Reciprocating tools which develop percussive action at the working end require pistons, valves and cylinders just like a steam engine. In effect, the expansion of air in the cylinder of such a tool reacts upon the piston to drive it against the head of the working tool. The number of strokes or impacts per minute vary, depending on the type of tool and work to be done. A modern rock drill strikes from 1600 to 2200 blows per minute.

Rotary Air Tools

In rotary tools, the air acts upon vanes set lengthwise in slots along a cylindrical rotor, or against the blades of an impeller attached to the main shaft. In a rotary vane device, the vane slots on rotor, as well as the supporting ball bearings, must be lubricated. The speed of operation of drills and grinders depends upon the air pressure and most are designed to be operated at 90 pounds of air pressure. Operation at a higher air pressure will result in excessive speed, creating a serious safety hazard from broken grinding wheels and bits. When it is further desirable to control the speed, planetary gears driven off the rotor shaft may be included. Field lubrication and maintenance is very important for the safe, productive operation of a pneumatic tool.

Lubrication of Air Tools

Regardless of the type of pneumatic tool used, proper lubrication is the most important factor to keep in mind, and I emphasize **proper**. This is the single most important factor responsible for the service life of a paving breaker or spike driver. These type tools can be severely damaged during the first few minutes of operation if not properly lubricated. The methods used to provide adequate lubrication is dependent upon actual operating conditions.

Pneumatic tools of the heavy duty type are lubricated by an oil reservoir built into the tool itself, usually in the handle. For short duration jobs, adequate lubrication can be provided by periodic addition of the recommended oil to the lubricating oil reservoir in the handle. If operation is intermittent and air supply hose does not exceed 49 feet in length, a compressor-mounted lubricator can be used. If operation is continuous, that is eight hours a day, an air line lubricator should be installed within 12 feet of

Continuous lubrication of the parts of any high-speed mechanism is most important. Failure of a bearing or gear or sticking vane can rapidly lead to other mechanical difficulties until the tool becomes inoperative, causing costly downtime.

As mentioned previously, the best method of lubrication is the air line lubricator. The oil is picked up by the air stream and atomized to be distributed over the reciprocating or rotating parts to keep them well protected with a suitable film of oil. Constant renewal of this film is necessary, however, because just as the air carries oil to the parts on inlet to the tool, so will it tend to carry off oil as it exhausts. Modern type air line lubricators, such as Norgren's, utilize a flow sensor design which provides a nearly constant oil/air ratio over a wide range of air flows. It prevents tool starvation when airflows are low or flooding when airflows are high. There are two types of air line lubricators, the oil-fog and the microfog. The oil-fog puts tiny droplets of oil into the air stream and is good when the tool being used is close to the lubricator itself. However, the micro-fog lubricator uses only a small percentage of the oil drops that are visible in the oil sight feed dome and atomizes it as a fine (2 micron) light aerosol. Micro-fog can be transmitted over relatively long distances without wetting out before arriving at point of need. However, no matter what type of air line lubricator you use, always use an air line filter in front of a regular and lubricator. If you have to use a long length of hose to get to a difficult area, utilize a portable filter-regulator and lubricator enclosed in a metal band frame. The oil level in the line lubricator should be checked at the beginning of each eight hour shift, and once during the shift. Always clean the area around the filler plug before filling. Every effort must be made to avoid oil contamination from dirt and other impurities, and stored in a sealed container. Kilfrost is an effective extreme pressure lubricant which maintains excellent film strength under severe conditions encountered in outdoor use of air tools and prevent formation of ice in and around exhaust ports and valves. It is easily fed by air line lubricators. Due to its unique ability to permanently absorb moisture Kilfrost is an excellent anticorrosion agent and has been adopted for year-round use by firms whose pneumatic equipment is subject to severe corrosion conditions. One word of caution — it is not an additive and should not be mixed with ordinary tool oils, as this will impair its deicing properties.

Gear Lubrication

Gear lubrication in a rotary pneumatic tool, such as a grinder, drill or impact tool, must be carefully approached and a suitable low-torque type of grease used. Resistance to oxidation is important because the grease in such a gear set is churned rapidly in service and subject to considerable temperature and exposure to air. Internal friction in a sluggish grease could cause a serious rise in temperature, while on the other hand, too much grease injected into a gear housing will cause the tool to heat up and the excess grease will work out around the arbor. Therefore, usually after eight hours of operation the gear box should be lubricated in accordance with the manufacturer's operation manual. The grade of grease recommended by the manufacturer may vary from tool to tool.

Proper Air Supply

Proper air supply begins at the compressor — know the CFM capacity of your compressor. It is usually located on the identity plate or in the instruction booklet. Also, know the CFM usage of your tools. This information can be obtained when you select the tool for purchase. By having this information you can assure each tool has ample air to do the job. Depending on the application, standardize your air hose to accommodate the largest air tool you are using and also proper size fittings. When you are in an area where longer lengths of air hose are required add just enough sections of standard length (25 or 50 feet) to get the job done. Then remove the excess hose and store it. By using shorter lengths you decrease the pressure drop caused by friction loss and insure the tools effectiveness.

A percussion or impact tool is designed to operate:

100 percent efficient at 90 PSI running line pressure

94.5 percent efficient at 85 PSI running line pressure

87 percent efficient at 75 PSI running line pressure

75 percent efficient at 65 PSI running line pressure

62 percent efficient at 55 PSI running line pressure

47 percent efficient at 45 PSI running line pressure

If you have smaller tools that need smaller air fittings utilize a whip-short length of smaller air hose with a large air coupling at one end for connection to the large air hose and a small air fitting at the other end to connect to the tool. If possible keep your air hose laid out straight instead of looped around a post as this will improve air delivery and aid in air line lubrication.

Preventive Maintenance

When you have finished using an air tool and it will lay inactive over the weekend or until the next job, flood the tool with lubricating oil. This can be accomplished two ways. Disconnect the tool at the air coupling inlet and pour in a quantity of oil while pulling on the trigger, although the best method is to use a portable Flush/Lube System. This "Y" = system consists of an air line, air filter and two air line lubricators with the sight feed dome adjustment knob turned all the way open. You plumb it inside a frame support stand with three ball valves to control the operation of the unit. Connect the tool to the short air hose on unit; open ball valve that goes to one lubricator filled with kerosene (special adjustment knob and fill port is available from air supply house). Operate the tool with rag near exhaust and run until black gunk comes out (usually 20 to 30 seconds). Stop tool, shut off ball valve No. 1 and open ball valve No. 2 that puts in clean filtered air and with rag near exhaust, run until kerosene is blown out. Then shut off tool and ball valve No. 2 and open ball valve No. 3 that allows second lubricator filled with oil to flood tool until oil appears on rag near exhaust, disconnect and store. You have effectively removed water and contaminates from inside of tool and prepared it for storage insuring minimum rust damage while tool is inactive. On percussion-type tools, such as a scaler, paving breaker, riveter or air hammer, never operate tool unless a chisel or accessory is inserted in tool and held against a solid object. To do so otherwise may damage the piston.

Air Line Lubricator Test Results

The C. A. Norgren Company performed a test using two identical air operated screwdrivers. One was lubricated with a micro-fog lubricator unit and the other received no lubrication. As a result of the test, calculations were based on the air tools operating 2000 cycles per eight hour day, five days a week and Norgren arrived at the following conclusion. The unlubricated tool failed initially after 71,400 cycles, this would have been maintenance-free operation of only seven weeks. This same air tool failed completely after 101,400 cycles equivalent to only ten weeks operation. The micro-fog lubricated air tool operated efficiently 2,101,400 cycles at which time the test was stopped. This represented 4.2 years of maintenance-free operation and the tool was still in satisfactory operating condition.

Engine Drill

This particular tool has proven a boon to the B&B man in the field. It is manufactured by Tanaka Company and is a Model TED-232 gas powered engine drill. It delivers 1.2 horsepower, yet weighs only 8.8 pounds. Add to the powerful engine, a heavy duty clutch, 20-1 heat treated reduction gear box, plus heavy duty needle ball bearings, an all position carburetor and you have the flexibility necessary to handle the toughest jobs under the roughest conditions. Working with electric power around water or in wet weather can be dangerous. A gas powered engine drill ends these hazards.

At 8.8 pounds, allowing increased portability, you can eliminate long extension cords, heavy power generators and burned out drill motors, at a cost of approximately $200. Recently, the Tanaka Company has introduced a two-speed reversible engine drill which also has the capabilities of a hammer drill by turning a shift lever.

The versatility of these engine powered drills is endless. Bridges, crossings, signs, footwalk and handrail, or any type of remote site drilling. This, as any tool, also requires periodic maintenance and care. A clean mixture of fuel is required and should be mixed and stored in a clean container. As with most newer model gas operated tools, the mixture is 50:1.

As outlined in the operators manual furnished by the manufacturer, periodic cleaning of the air breather and gear box lubrication is required after usage.

Electric Tools

In most instances, the cost of first line electric tools is about half of that of air tools which, in turn, costs less on an average then hydraulic tools. The power source for electric tools is usually less expensive than for the other types of tools.

Contrary to some lines of thought, electric tools also require lubrication. This is not limited to a squirt of oil on the shaft, but actual gear box lubrication. This is very important in determining the useful life of an electric power tool, whether a circular saw, drill, grinder, etc.

New tools are lubricated at the factory and this should be sufficient to last two to six months depending on the amount of use the tool receives. Tools used constantly on heavy duty production jobs require lubrication more often and tools which have not been used for an extended period of time should be relubricated before being put back in service.

When placing a new tool in service, enclose a copy of the "Care and Operating Instructions Manual" supplied by the manufacturer and instruct your foreman to note dates of lubrication on manual or card kept with the publication.

Electric Power Plants

Logically, if you use an electric-powered tool in an isolated area you will require a power source, which usually would be an electric power plant.

The present electric power plants are relatively lightweight. For example, a 5 kilowatt power plant can be easily carried by two men and will provide adequate power for most tools except chain saws. Heavy impact tools should not be operated with another tool or on long extension cords or for long periods of time with the 2.5 kilowatt plants. This would not be the case with a 5 kilowatt power plant since it has adequate capacity.

To be productive and efficient, a power plant also needs care and maintenance. The oil should be checked prior to each usage and changed after approximately 40 hours usage and when being stored. Periodically a new spark plug should be installed and when working in dusty area, the air cleaner should be cleaned on a daily basis. As with any gasoline powered tool, a clean and properly stored fuel should be used.

When transporting a power plant, make sure that it is properly secured to prevent damage from bouncing around or falling off of a vehicle. An inoperative power unit in an isolated area costs you money.

Extension Cord Chart

When an extension cord is used, it should also be a three wire cord to permit proper grounding of the tool. As the distance from the supply outlet increases, heavier gauge extensions are required. The use of extension cords of inadequate sized wire causes a serious drop in voltage, loss of power and possible motor damage. This table is based on limiting line voltage drop to five volts at 150 percent of rated amperes.

Observe your work area and when stringing out cord, make sure that it will not be cut or damaged nor lying in a pool of water. Eliminate any tripping hazard, if possible, put your wire overhead. It will save your cord from abuse.

Storage and Care

Needless to say proper care and maintenance of a tool can and will greatly prolong the life and usefulness of a tool, therefore, reflecting a monetary savings.

When purchasing a new tool, provide a storage box for it, whether it be a commercially available box or constructed from plywood scraps.

How many times have you seen a man throw a tool in the back of a truck and then drive away with the tool bouncing and doing flip flops and later wonder why the handle is broken or the cord cut or frayed.

Store your blades, steels and bits properly. Broken, bent, dull, chipped and rusty appliances for tools, whether it is a circular or chain saw, buster, spike drive or whatever, is not efficient and is overworked with faulty parts.

Take a few moments prior to starting a project to make sure your tool is safe, clean and operates properly. After each usage make sure that the tool is cleaned and stored properly. Inspect cords and air hoses for cuts and breaks. A short in an electrical cord or a broken and whipping air hose is a serious matter. A greasy handle on a buster or spike drive or saw makes it not a tool but a lethal weapon to the operator. A safe tool is a productive tool.

It is recommended that each operator read the instructions that come with the tool regarding lubrication and operation even though he may be an ``old hand'' at using the tool. We are never too old to learn. Remember, we use power tools to assist us in doing the job better, faster and more efficient. Take care of the tool and the tool will be a useful partner. Thank you for your attention.

President Bessey: This report is of real interest to me. I think this presentation points out that maybe we should take a good look at our tools. If we are a pneumatic railroad, how about hydraulics? If we are a hydraulic one, what about pneumatics? I think this points out that we should look and see what the job consists of. Just because we've been using a certain type of tool for generations does not mean that is the best way to operate. You might say it costs money, but it also costs money not to use the right tools. It's a very good subject and I think its something we'll all carry back to our railroads. This session will be adjourned until 1:30 this afternoon when we will reconvene here in the Adams Room.

TUESDAY AFTERNOON

September 16, 1986

President Bessey: Welcome to the continuation of the second session of this conference. Will everyone please be seated. I would like to call on Mr. Ray Tallent to introduce the next special feature and our guest speaker.

Mr. Tallent: Thank you, President Bessey. Mr. Phillips is a graduate of Wentworth Institute of Technology, Boston, Massachusetts, in Building Construction Technology. He has taken various night courses and attended many seminars to broaden his knowlege of building construction subsystems. Ron has been employed by Southern Railway in the Office of Architectural Services for 14 years, where he is currently an architectural-engineer. Ron is a member of the American Railway Bridge and Building Association, the American Society of Plumbing Engineers, and the American Railway Engineering Association, where he is immediate past chairman of Committee 6-Buildings. Mr. Phillips.

SPECIAL SUBJECT NO. 3

ROOFING SYSTEMS

Chairman: R. E. Phillips, Proj. Mgr., Southern, Atlanta Ga

Good Morning. I originally agreed to make this presentation, not because I knew a lot about roofing, but because I knew very little about roofing. I felt this would be a challenge and a good reason to learn all there is to know about roofing. After a few weeks of research I learned something very important. There is no way anyone can learn all there is to know about roofing in a few months time. Ten or fifteen years ago it may have been possible but not today. Back then if you had a sloped roof you would use asphalt roll roofing, asphalt shingles, clay tile, slate, wood shingles or metal roofing. If you had a flat roof you would choose a built-up roofing system which is comprised of several layers or plies of roofing membrane or felts laid over insulation or the roof deck, with asphalt or coal tar waterproofing bitumen between the piles. That was about all you had to choose from.

Over the past decade there has literally been a revolution in the roofing industry. Single-ply roofing and, to a lesser degree, sprayed-on coatings have had a great impact on roofing construction practices.

The rapid growth in the use of single-ply membranes is illustrated (figure 1) by data from the National Roofing Contractors Association. This data indicates that the annual use of single-ply roofing has gone from about two percent of the installed membranes in 1975 to about 40 percent in 1983. It was recently published in Engineering News Record that the single-ply market share has passed 50 percent.

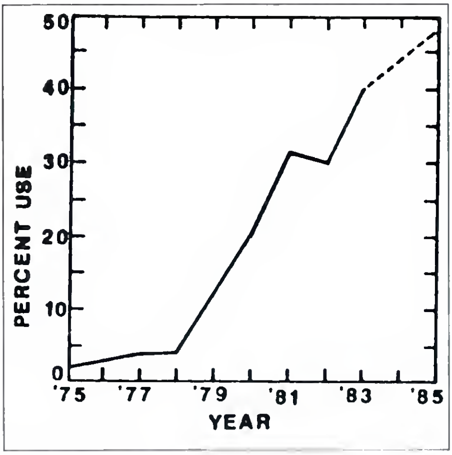


Figure 1 — Per cent use per year of single-ply membrane materials according to the National Roofing Contractors Association (NRCA) project pin point data.

Single-ply roofing falls into four basic categories. The first being vulcanized elastomers. Terpolymer of ethylene propylene and diene monomer (EPDM) and neoprene fall in this category. Chlorosulphonated polyethylene, chlorinated polyethylene and polysobutylene are nonvulcanized elastomers. The thermoplastics category includes polyvinyl chloride (PVC) and the fourth category is modified bitumens where styrene-butadiene, styrene and atatic polypropylene are commonly used for asphalt modification.

With many other products falling into these four basic categories you can see that the roofing industry has become very technical and thus specialized over the past few years.

Most of the people in this room are called upon to perform roof maintenance as well as to oversee and inspect new construction. The movie we will be seeing shows installation methods for different kinds of single-ply roofing systems. Please note that no matter what system is being used, attention to details is very important. Lap joints and flashing must be done correctly and in accordance with the manufacturers' written instructions. The best roofing materials will not perform if they are not properly installed; even the smallest details can make the difference. If you are called upon to oversee a roof installation or roof repair be sure to get the roofing manufacturers' written installation instructions and study the details. Be sure you know what you are getting. Let's turn down the lights and watch the movie “”Design Factors for Membrane Roofing Systems” (c), produced by the Roofing Industry Educational Institute, Englewood, Colorado.[1]

Narration

For over a century, the designer of a building with a low-sloped roof had very little choice in the way of roofing systems. The lack of slope required a membrane roofing system and the only thing he could choose which would be practical and economical was one version or another of the traditional hot-applied, bituminous built-up roofing system. In recent years other roofing systems, the so-called single-ply or Elasto/Plastic roofing systems, have been developed to the point at which they are both practical and economically competitive with the bituminous built-up roofs. The newer systems also have the advantages of flexibility and ease in application procedures, but the traditional bituminous roofing systems are still with us and are still a very effective solution to weatherproofing a roof on most structures.

In this film we will consider both the older and newer roofing systems in terms of how each of their components meets the requirements of the elements of a membrane roofing system. We will assume that the building's structure is capable of supporting the roofing system and its expected live loads without undue deflection. The deck must not only perform the same functions, but must be chosen in terms of the roofing system which it will support.

While an uninsulated membrane may be installed directly over a poured concrete deck, a steel deck requires insulation to span the spaces between the flanges and resist the loads to which the membrane will be exposed. Preparation of the deck to receive the roofing system may involve more than just cleaning the surface. Drains and other equipment must be installed at the proper height and position. Care must be taken not to locate roof penetrations in places where they cannot be properly flashed, where they will make roofing application impossible or where they may block drainage. If the deck has not been designed with adequate slope to drain, this must be accomplished by means of a shaped, insulated fill such as this proprietary system consisting of a poured vermiculite concrete deck and expanded polystyrene boards over a ribbed, perforated sub-deck; a preshaped, tapered board insulation system such as this using expanded perlite board; or a system in which uniformly thick board insulation is laid in steps and machine ground to a slope on the job.

If the materials which follow will be adhered to these surfaces, or to a concrete deck, the surfaces are generally primed with a compatible primer to make sure they are suitable to provide for a good adhesive bond. Hot, bituminous BUR systems, and most of the Elasto/Plastic systems, require wood blocking as thick as the insulation at membrane terminations to permit nailing of flashing metal or for mechanical fastening of the membrane. Cant strips are also required with hot-applied bituminous built-up roofing systems and some of the Elasto/Plastic systems to break the angle between the horizontal and vertical surfaces.

The next consideration is attachment of the roofing system to the prepared deck. Attachment may be by mechanical means, such as nailing; by full adhesion such as this hot applied built-up system in which the insulation is mopped to the insulation; a combination of methods, such as mechanically securing a first layer of insulation then adhering the balance of the system to avoid piercing of the vapor retarder with the fasteners; or even by depending entirely upon ballast to hold the roofing system to the deck as is done with many of the newer Elasto/Plastic roofs.

The vapor retarder, if required, is the next consideration. There is no practical way of using a vapor retarder in an all-nailed construction. This dictates a fully-adhered system, as over a concrete deck; or a nailed layer of insulation followed by an adhered vapor retarder and a fully adhered or ballasted roofing system from there on, as typified by the ''nail one, mop one'' system used over metal decks in many hot-applied and built-up roofing systems; or, of course, a non-adhered, fully ballasted system.

The required amount of insulation can be loose-laid if it is to be a fully ballasted system or if further elements of the roofing system are to be nailed through the insulation to the substrate without a vapor retarder. It can be nailed if a vapor retarder has not been used and the remaining elements of the system are to be otherwise secured; or it can be mopped or otherwise fully adhered over a solid deck or over a vapor retarder as in this hot-applied, built-up roofing system.

The next element of the roofing system, the membrane, is that element in which the various membrane roofing systems differ most and which we will examine in the most detail. In a typical hot-applied bituminous built-up roofing system, the membrane consists of three or more layers of felt or glass mat which are hot-mopped with bitumen to the insulation and to each other. The temperature at which the mopping bitumen, which acts as both adhesive and waterproofing agent, is applied is critical — too cool, and proper adhesion does not occur; too hot, and the bitumen may degrade or become too fluid to provide adequate quantities of interply bitumen. This means that the temperature of the bitumen in the melting kettle or tanker must not exceed the maximum allowable which is specified and must also be kept below the certified flash-point temperature. Yet it must be kept hot enough all through the pumping and spreading process so that it emerges from the applicator or the hand mop at the proper temperature and viscosity for application, otherwise known as EVT.

Some bituminous built-up roofing systems call for a base sheet lapped 2″ at the edges, followed by two or three shingled ply sheets laid to the appropriate ply line marked on the felt so that at any one point there are at least the specified number of plies. Specified minimums and maximums of mopping bitumen must be followed so that there is enough bitumen for proper adhesion and waterproofing, but not excessive quantities which actually reduce the physical properties of the membrane and promote slippage.

The completed built-up roofing membrane may receive a flood coat of bitumen in which is embedded a specified quantity of aggregate for protection from the sun's rays. Mineral-surfaced cap sheets are sometimes used as the surfacing ply of the membrane for the same purpose. Over inorganic felts, just a top coating of hot bitumen is sometimes used as the final surfacing, but periodic recoating is usually required over the life of the roofing system. Other decorative or protective coatings may be used, such as aluminized bituminous coatings to reduce the sun's heat load, but these also require periodic recoating.

The Elasto/Plastic membrane systems break down into three general categories: rubber-like elastomeric materials; thermo-plastics, such as polyvinyl/chloride; and the various bituminous sheets. The modified bituminous materials are compatible with bituminous built-up roofing membranes, or the bitumens found in most insulations or other substrates, and can be laid directly on them. However, contact between the vinyls and bituminous materials or some foam insulation can lead to plasticizer migration and embrittlement of the membrane; so a separator layer such as polyester fleece, polyethylene foam or treated kraft paper is used as a divorcing sheet. Most elastomeric membranes can be laid directly on a smooth bituminous surface, but as minor swelling or unwanted bonding can occur, some sort of divorcing layer is usually installed between them. PIB membranes are compatible with asphalt and commonly used roof insulation, but a separator layer must be used over materials containing coal tar pitch.

Once the substrate has been prepared and the method of attachment of the membrane has been established, the next step depends on the nature of the roofing system. Loose-laid or partially adhered and some fully adhered roofing systems require field joining of side and end laps. Elastomeric sheets are often factory assembled into large sheets because it is easier to make the lap joints before vulcanizing. In field joining, the edges of these EPDM sheets are folded back and solvent-cleaned then both mating edges are coated with a contact adhesive. When the adhesive is dry, the edges are mated and immediately bonded. They are rolled to ensure complete contact and the exposed edges caulked with a gun grade sealant. As with hot built-up roofing systems, they are lapped in the direction of water flow or sometimes parallel to it.

Lap edges in a PVC roof membrane are solvent-welded or heat-welded or a combination of both. No effort is made to lap the seams in the direction of waterflow because the seams are actually fused rather than adhered. A THF solvent is used in solvent-sealing. After cleaning with a rag, the solvent is applied with a brush then a small sandbag is used to hold the edges together for a few seconds until they fuse. Vinyl seams can also be solvent-welded with a machine such as this. In either case, after seaming the roofer probes for gaps and closes any with a heat-gun and roller. Then the seams are caulked with liquid PVC. Some PVC, chlorinated polyethylene and Hypalon membranes are completely heat-welded, instead of using solvent welds. The seaming is done with a heat-gun and roller as seen here; or, by the use of an automatic heat welding machine. It is still necessary to check for gaps, close them and, in most of these systems, to caulk the edges.

In this loose-laid modified bituminous system, the sheets are rolled out and positioned then a special propane torch is used to seal the side laps. In any torch-joined or torched-on roofing system, careful consideration must be given to composition of the substrate in order to avoid fire hazards and degradation of other elements of the structure or roofing system. The roofer uses a trowel to complete the seal and smooth the edges. End laps are fused with a regular propane torch. Another loose-laid modified bituminous system uses a self-propelled machine to heat-fuse the edges.

There are several methods of partially or fully attaching the roofing membrane to the substrate. This elastomeric sheet, being fully adhered over a felt-topped insulation board, is first positioned next to an already adhered sheet then rolled back on itself. The substrate and exposed underside of the sheets, except for the lap area, are coated with contact adhesive. After drying, the sheet is rolled back and smoothed. Lap edges are coated with another type of contact adhesive and, after drying, joined and pressed with a roller then caulked with a paste sealant. The other half of the sheet is then handled in a like manner.

In this fully-adhered PVC system, the adhering to the substrate is handled in a similar way; but the lap edges of the membrane sheets are heat-welded together with a self-propelled hot air welding machine. This elastomeric membrane uses a latex adhesive instead of a contact adhesive for adhesion to the substrate. Unlike contact adhesives which grab as soon as they touch, the latex adhesive gives some open time so that misaligned sheets can be shifted and wrinkles can be corrected. The lap edges of the membrane, however, are contact cemented.

Some of the modified bituminous membranes are fully adhered to the substrate with hot bitumen in a manner very much like hot-applying a heavy coated bituminous roofing cap sheet. In this system, a fiberglass base sheet is mopped over the substrate; then the mineral-surfaced modified bituminous membrane sheet is rolled out and smoothed. Mineral granules are used for appearance and protection of the lap edges.

Several modified bituminous membranes are designed to be applied by torching with a propane torch. They literally carry their bitumen adhesive on their back instead of the bitumen being mopped on. The roofer uses a high-capacity propane torch to melt the bitumen and applies some heat to the substrate. Note the small wave of melted bitumen at the intersection of the roll of membrane and the substrate. Another roofer finishes the edges with a torch and trowel. A special torching machine with multiple heads accomplishes the job faster.

Another modified bituminous system uses a self-adhesive, pressure-sensitive membrane over a primed surface. Anti-stick paper backing is peeled off the membrane as the roll is pulled along and smoothed down with a roller or carpet smoother. The exposed edge of the overlap has a small area of adhesive on the top edge which, when activated by the sun, helps seal the seam edge.

Mechanical fastening and partial adhesion are also used to fasten some elasto/plastic roofing systems in place. In this elastomeric membrane system, 12″ square plates are fastened through the insulation and metal deck with screws at the intersections of the loose-laid insulation boards. The elastomeric sheet is positioned, rolled back and the plates and matching areas of the membrane are coated with contact adhesive. Then the sheet is rolled forward and broomed to assure good contact bonding. Side seams are contact adhesive bonded and caulked. The membrane areas adjacent to the roof edge are fully adhered to the insulation with contact adhesive for extra wind uplift resistance. This vinyl roofing system uses a similar method. Drive screws are driven through metal washers and vinyl discs and screwed to the underlying metal deck. Then contact adhesive is applied, bonding is accomplished and the side seams are heat-welded and caulked.

This PVC membrane is mechanically fastened with metal bars. The bars are laid out on the membrane and fastened through to the deck with self-tapping screws. The lap edges are heat-welded. Then strips of the vinyl membrane material are laid over the bars and heat-welded on each side. In this CPE system the roll material is fastened through the underlying materials to, in this case, a prestressed concrete deck through predrilled holes with drive screws and washers through the lap edges. Then the lap edges are heat-fused by machine or hand to complete the membrane.

Partially adhered, mechanically fastened and fully adhered elastomeric roofing systems usually require no further surfacing although some modified bituminous systems are given a reflective coating for sun protection or fire resistance. Loose-laid systems are usually ballasted with 10 to 13 pounds per square foot of specified ballast in order to resist wind uplift. This inverted roof membrane assembly employs a cement-faced polystyrene foam board as a combination of insulation and ballast.

The last major element of the membrane roofing system is flashing — treatment and extension of the membrane at the terminations — the roof edges, parapets, walls and expansion joints; and at penetrations, such as curbs, stacks and drains. At these terminations the roofing system is joined to a different type of material, usually takes an abrupt change in direction, may be faced with differential movement between the building elements and has to cope with all of this without allowing water or wind to enter beneath the membrane. Flashing details are critical to the success of any roofing system and they should be carefully designed and specified. Every critical junction should be considered and flashing details should be drawn in large scale with isometrics where necessary.

Hot-applied bituminous built-up roofing systems entail a myriad of flashing details, but they are almost all based upon multiple layers of felt or other membrane materials, adhered and waterproofed with bitumen and fastened at the high edge with nails.

Metal base flashing is not recommended, however, metal is used as counterflashing to provide a watershed over the top edge unless the base flashing is carried up and over the high edge as in a low parapet or gravel stop edge. One such traditional flashing detail, here being used in modified bituminous system, utilizes a mopped-in cant strip. A mopped base felt is applied. Then a strip of the modified bituminous material is back-mopped and the sheet is flopped back over the cant and out on the roof surface. Another strip is hotmopped and laid over the cant and up the vertical surface. It is nailed at the top edge and metal counter-flashing will be added later to complete the termination. Torched-on modified bituminous flashings are quite similar, except that cant strips are sometimes not used because of the extreme pliability of the heated membrane material.

Termination details on PVC roofing systems are quite different. Several systems use vinyl-coated flashing metal. At a parapet, the coated flashing metal is nailed to a wood nailer on the deck. At joints in the metal, a bondbreaker tape is used. A strip of vinyl membrane is welded over the joint. The horizontal flap is left loose for later welding over the roof membrane. The vinyl roof membrane is solvent-welded to the coated flashing metal. The flap is welded to the membrane; edges are caulked and metal counter-flashing completes the system. The same system is used at the gravel stop metal. At another gravel stop, the vinyl membrane is simply loose-laid over the wood cant and edge strip and nailed on the vertical face then a metal gravel stop is installed over the membrane.

EPDM membranes are flashed in the traditional watershedding method, but multiple layers are not used. Just single thicknesses of the membrane and an uncured flashing sheet are contact-cemented to each other and to the housing or parapet. Most of these systems are mechanically fastened at the perimeter and top of the flashing. Many of these roofing systems are standard flashing accessories, but others use specialized items as part of their system, like this vent pipe cover which is simply placed over the pipe and solvent-welded to the vinyl roof membrane.

Today there are many different roofing systems to choose from. Each of them, including the traditional hot-applied bituminous built-up roofing system, has its advantages and its drawbacks, but no matter which system is chosen in the final design, it must be compatible with the structure which is to support it. Every element of the system must be carefully considered, tightly specified and skillfully applied in order that the roof may do its job of protecting the building for a long, trouble-free life.

-END OF MOVIE-

As I stated earlier and as it was emphasized in the film, attention to installation detail is one of the most important factors in insuring a good roofing installation.

Approximately 5 percent of all new construction cost is channeled toward roofing, but 25 to 30 percent of all construction litigation results from roof failures. Thus, it is very important that the materials manufacturer and the roofing contractor be selected with great care.

WHAT TO LOOK FOR IN A MANUFACTURER

1. How long has the manufacturer been in business?

   Point: One or two years should cause reservations.

2. How long has the manufacturer been in this type business?

   Point: Old established firm may now just be entering this type of market.

3. Ask for references for the type of roof you will be using.

   Point: Successful firm should be able to provide end user and specific references for the type of work you are considering.

4. Are the manufacturer's products certified/credentialed or just tested?

   Point: Words like "Tested" or "Listed" can be misleading. The only programs that assure the integrity of the product are "U.L. Labeled" which is a continuous ongoing testing program and factory mutual which classifies roof assemblies for their fire characteristics and wind-uplift resistance for insurance companies in the U.S.

5. Does the manufacturer have a contractor certification program?

   Point: The best products are only as good as the installation. Indiscriminate selling to contractors should make the end user/specified wary.

6. Does the manufacturer offer a total systems warranty?

   Point: Is the manufacturer willing to stand behind its product and its certified contractors workmanship.

7. Who is the warranty from and to whom?

   Point: A joint warranty from the manufacturer and contractor could be null and void if either party leaves the industry.

8. Will the manufacturer be there in the future to honor its warranty?

   Point: Examine the manufacturer's past history and its strengths.

WHAT TO LOOK FOR IN A CONTRACTOR

1. How long has the contractor been in business?

   Point: A new company could be a problem.

2. How long in "this" business?

   Point: If this is a new division of a long term, established company, is it a "casual" service?

3. Ask for references for the specific type of work you will be doing.

   Point: With many different types of roofing available, references should be for the specific type of system you will be using, not just for roofing in general.

4. What is the contractor's technical expertise?

   Point: Does the contractor really understand the specific products being used and their application?

5. What type and quantity of equipment does the contractor have?

   Point: There is a myriad of equipment available with a a very wide range of sophistication and production. Does his equipment accommodate your job?

6. Is the contractor certified by the manufacturer?

   Point: Reputable manufacturers have a contractor certification program. If the contractor is not certified his only alternative is to alter your specification. Are his products equal?

7. Can the contractor bond the project?

   Point: Contractors with a good work history have bonding capabilities. Bond your work.

8. What is the contractor's financial expertise?

   Point: Regardless if your job is $2,000 or $2,000,000, it is all relative. Is the contractor capable of managing your money?

9. What is the contractor's financial stability?

   Point: Is your job the one that will make or break him? Check his credit.

In conclusion, a roof is a very important part of every building. Don't take its installation for granted. Select a manufacturer and contractor carefully. Study the manufacturer's products; study the written installation; know what you are getting. For additional information there are many organizations you may wish to contact.

The National Roofing Contractors Association, Chicago, Illinois, publishes a Roofing and Waterproofing Manual, a Steep Roofing Manual, the Handbook of Accepted Roofing Knowledge, a Manual of Roof Maintenance and Roof Repair and the Commercial, Industrial and Institutional Roofing Materials Guide. They also have various audio/visual instructional programs for loan.

The Single-Ply Roofing Institute, Glenview, Illinois, publishes "Single-Ply Roofing: A Professional's Guide to Specifications."

The Roofing Industry Educational Institute, Englewood, Colorado, has an excellent roof maintenance manual. They also hold roofing seminars at various cities throughout the U.S. and they have many audio/visual programs for loan.

Most states have Roofing Contractors Associations that are more than willing to give you information and many manufacturers sponsor informative seminars about their products.

Again, know the product, know the installation methods, know that you are getting a quality roof.

Thank you.

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[1] The movie "Design Factors for Membrane Roofing Systems" and the narration of the movie are copyrighted by the Roofing Industry Educational Insitute. All rights reserved. No part may be reproduced in any way, or by any means, without permission in writing from the Roofing Industry Educational Institute.

President Bessey: Thank you very much, Ray and Ron, for that fine presentation. A lot of new innovations have appeared in the roofing industry and luckily so, as railroads have a lot of roofs to be concerned about. Are there any questions? If not I would like to call upon Mr. Jim Williams at this time. Jim is our immediate past president and he will introduce all the past presidents who are in attendance today. Mr. Williams.

Mr. Williams: Thank you, Don. We have a total of six past presidents with us here today and I ask that they please stand and be recognized. President 1957-1958, W. H. Huffman, retired, Chicago and North Western. President 1966-1967, R. D. Helleweg, retired from Amtrak, and I can remember when he was with the GM&O. President 1976-1977, J. R. Williams, now with Alfred Benesch, and I can remember when Jack was with the Rock Island. President 1978-1979, Wally Sturm, EJ&E Railway. President 1983-1984, Jim Budzileni from the ICG and I can remember Jim from the Rock Island also. President 1984-1985, myself, just recently retired from the EJ&E Railway. (Applause)

President Bessey: Thank you, Jim. And on behalf of the Association, I certainly want to thank all of you for being present today. I think that if you look around you will see that a lot of the past presidents are working with us these two and a half days during the conference. Jim

Williams, of course, has to work because he is the immediate past president and has a lot of duties to perform. We had some missing people and Jim Budzileni took over and we appreciate that. Wally has always been active and this year he made the signs. Jack Williams has a position on the Auditing Committee, so we really appreciate the fact that these past presidents remain active, and I guess you all have laid the ground work for me because I guess I will also be a past president. I would like to make mention of another past president, some bad news and some good news, and it concerns Omer Denz. The bad news is that earlier in the spring he was involved in a very serious car accident, had a fractured pelvis, ruptured spleen, lacerations, and was in very bad shape. I talked to him about a week ago and he is doing great right now. Omer would have been here, and hopefully, will make it to Kansas City next year.

Mr. Jim Williams, as immediate past president is chairman of the Nominating Committee and will present the slate of candidates recommended by the Committee for considerations as officers for the year 1986-1987. Jim.

NOMINATING COMMITTEE

Mr. Williams: Thank you, Don. Members of the Association, the Nominating Committee respectfully submits for nomination the following slate of officers. For President, John T. Kapp, Project Manager Construction, Conrail, Philadelphia, Pennsylvania; Senior Vice President, Donald J. Lewis, Senior Structural Designer, Illinois Central Gulf Railroad, Chicago, Illinois; Junior Vice President, Ray A. Tallent, Jr., Project Engineer-Structures, Norfolk Southern Corporation, Atlanta, Georgia; Junior Vice President, Byron T. Burns, Steel Bridge Inspector, Santa Fe Railway, Topeka, Kansas. For Director, for the term ending in 1988, Kenneth E. Bruestle, Bridge Engineer, Burlington Northern Railroad, Seattle, Washington; John H. Smith, Engineer Buildings and Facilities, Illinois Central Gulf Railroad, Chicago, Illinois; John J. Horney, General Structures Construction Engineer, Union Pacific Railroad, Omaha, Nebraska;. For Director for the term ending 1989, Mark C. Walbrun, Manager Engineering Design, Amtrak, Philadelphia, Pennsylvania; Edward Bond, Chief Engineer Bridges and Structures, Norfolk Southern Corporation, Atlanta, Georgia; Donald L. Steele, General B&B Supervisor, Union Pacific Railroad, Omaha, Nebraska. For Director for term ending in 1990, C. E. Thompson, B&B Master, CP Rail, Burnaby, British Columbia; J. A. Van Huis, Bridge Engineer, Chicago and North Western Transportation Company, Chicago, Illinois; H. L. Davidson, General Supervisor B&B, CSX, Nashville, Tennessee. For Treasurer, James M. Williams, Supervisor B&B (retired) Elgin, Joliet and Eastern Railway.

To fill the vacancy for Honorary Member that has occurred with the death of Mr. R. E. Dove last year, I nominate Herb M. Wilson, President, (retired) F. K. Ketler Company. Herb served as president in 1965-1966 and also served on the audit committee for many years.

President Bessey: Thank you, Mr. Williams. You have heard the slate of nominees recommended by the Nominating Committee. I will accept a motion that the slate submitted by the Nominating Committee be elected. Do I have a motion?

Member: So moved.

President Bessey: You have heard that a motion has been made. Do I hear a second?

Member:I second.

President Bessey: The motion has been made and seconded that the slate of candidates recommended by the Nominating Committee be elected to the offices specified. All in favor signify by Aye. Those opposed signify by Nay. The Ayes have it. I hereby declare these officers duly elected. Will the newly elected officers please stand to be recognized? (Applause) Thank you, gentlemen.

We will now proceed with the business session and provide the necessary reports. If there are any questions concerning any one of the reports, I request that you hold your questions until after the report has been given.

Will our efficient and amiable secretary, Mrs. Pat Weissmann please give the Secretary's report. Pat.

MEMBERSHIP REPORT
September 1, 1985 Through August 31, 1986

Total members, September 1, 1985		724
New members since September 1, 1985		37
Members reinstated		1
		762
Less: Dropped — Active	48	
Associate	14	
Life	4	
Deceased — Active	1	
Associate	1	
Life	10	78
Total members, August 31, 1986		684

Thank you.

President Bessey: Now, will the Treasurer, Jim Williams, present the Treasurer's report.

Mr. Williams: Well, if you have been with us a number of years, we have always been between tooth and nail and it came out a little bit better this year.

TREASURER'S REPORT
September 1, 1985 Through August 31, 1986

Cash on hand, September 1, 1985		$ 3,377.81
RECEIPTS		
Dues	$ 6,160.00	
1985 conference receipts	15,800.00	
Advertising — 1984	625.00	
1985	12,975.00	
Miscellaneous	352.55	
Interest on checking account	255.92	36,168.47
		39,546.28
DISBURSEMENTS		
Salaries	$ 6,851.19	
Payroll taxes	607.96	
Office expenses	1,070.87	
Equipment rent, repair and purchase	1,618.78	
Printing	544.06	
Membership certificates	67.16	
Office supplies	232.28	
Advertising — 1984	358.75	
1985	41.35	
Conference expenses — 1987	34.74	

Proceedings	13,077.00	
Postage	971.50	
Miscellaneous	373.26	
Overpayment of dues	410.00	
Transfer of funds to savings	10,000.00	36,258.90
Cash in checking account, August 31, 1986		$ 3,287.38
Homewood Federal S&L Money Market	$ 5,227.93	
Homewood Federal S&L Six Month Certificate	5,000.00	10,337.93
Total funds, August 31, 1986		$13,515.31

President Bessey: Thank you, Jim. Are there any questions? If not, we'll go on to the Auditing Committee's Report and Mr. Jack Williams to present that. Jack.

AUDITING COMMITTEE REPORT

To the Members of the American Railway Bridge and Building Association:

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period September 1, 1985 through August 31, 1986, and have found them to be correct as of August 31, 1986.

(signed) J. R. Iwinski, Chairman
(signed) J. R. Williams
(signed) W. C. Sturm

President Bessey: Thank you, Jack. I would now like to call on John Horney to give the Necrology Report. John.

NECROLOGY REPORT

To: President and Members of the American Railway Bridge and Building Association

It is with grief and regret that we report the known loss of 13 members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of anyone, please report their names to the Secretary. The following have been reported since our last Annual Conference in September, 1985:

ACTIVE	TITLE-COMPANY-LOCATION	JOINED	DECEASED
R. W. Lee	Supv.B&B Southern Railway Muscle Shoals AL	1961	1986
ASSOCIATE			
M. J. Crespo	Engrg.Spec.Trans. Bechtel Corp. San Lorenzo CA	1956	1986

HONORARY			
R. E. Dove	Associate Editor RT&S Elmhurst IL	1934	1985
LIFE			
H. W. Celander	Asst.Engr. CMStP&P Schaumburg IL	1959	1986
J. V. Duchac	Supv.B&B C&NW Antigo IL		
S. E. Kvenberg	Supv.Bldg.Mtce. CMStP&P Woodbridge VA	1932	1985
H. C. Little	Supv.Water Svce. IC Hazelhurst MS	1948	1985
G. P. Lokotzke	Supv.B&B EJ&E Merrillville IN	1947	1985
J. M. Salmon, Jr.	Chf.Engr. Clinchfield RR Erwin TN	1938	1986
R. H. Smith, Jr.	Chf.Engr.M/W Conrail Wayne PA	1957	1986
C. H. Thatcher, Jr.	Divn.Off.Engr. C&NW Shakopee MN	1958	1986
R. Wall	B&B Supv. Southern Ry. Selma AL	1948	1985
W. B. Warfield	Supv.M/W Matl.& Equip. Penn Central Baltimore MD	1951	1985

I would like to ask for a moment of silence in honor of our deceased members.

Respectfully submitted,
John J. Horney

President Bessey: Thank you, John. Are there any questions regarding these reports as presented by the Secretary, Treasurer, Auditing Committee and the Necrology Committee? If there are no questions or discussion, I will request a motion that these reports be approved as given.

Member: So moved.

President Bessey: Is there a second?

Member: I second.

President Bessey: The motion has been made and seconded. All in favor signify by saying Aye. Those opposed, Nay. The motion is carried and the reports are approved.

We are running a little ahead of schedule at this time and we have a 20 minute bridge replacement slide presentation and then that will put us back on schedule.

REPLACEMENT OF PIN CONNECTED WROUGHT IRON TRUSS SPANS

Don A. Bessey

Senior Architect
Envirodyne Engineers, Inc.

This is the replacement of Milwaukee Railroad bridge G-276 located south of Knowlton, Wisconsin. The bridge consisted of three pin connected wrought iron truss spans of 135 foot, 218 foot and 147 foot, single track, supported on masonry piers and abutments. The bridge was constructed in 1894 and had a very light load-carrying capacity, had a clearance restriction and had been severely damaged by strikes from shifted loads. The bridge originally spanned the main channel of the Wisconsin River; however, a dam was constructed at the confluence of the Wisconsin, Eau Claire and Little Eau Pleine Rivers forming Lake DuBay, so the bridge spans the backwaters of that dam.

The single track bridge also carried State Highway No. 34 on a single lane, ten foot wide, wood plank cantilever roadway. It was, therefore, necessary for the State Highway Department to construct a new bridge to carry the highway before the railroad could replace this structure.

The construction of a new railroad bridge was necessary to improve the weight and clearance restrictions of the old bridge and to be able to handle unit coal trains to serve a new coal-fired generating plant at Weston, Wisconsin. The bridge replacement consisted of the removal of the three truss spans and the replacement with a center truss span and two girder spans on east and west approaches. The 135 foot truss span on the east end was replaced with 53 foot and 82 foot through girders, the 218 foot truss was replaced with a new truss span and the 147 foot westerly truss was replaced with 66 foot and 81 foot through girders. The short 53 foot girder span provided a 7 foot clearance above normal pool to accommodate recreation boaters. The average clearance under the balance of the structure is 5 feet.

The process of changing out the spans commenced on the weekend of June 6 and 7, 1981, when the westerly truss was removed and replaced with two girder spans. The second change out occurred on the fourth of July weekend, when the existing 218 foot truss span was removed and the new 218 foot truss which was assembled adjacent to the old bridge was floated into place. This float-in process was carried out in less than two days, or approximately 44 hours. The third changeout which involved removing the easterly truss span was carried out on July 18 and 19. The entire changeout process required less than five days of outages and it was not necessary to detour any trains.

Here is an aerial view of the old railroad bridge and the new highway bridge. The highway bridge was not in service when this picture was taken.

This is of the three old truss spans, with a view of the damaged end post. You can see the single lane highway that cantilevered off the bridge.

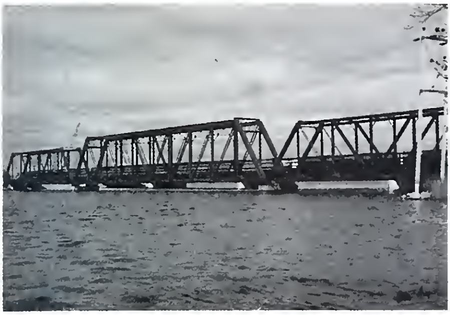
This is the south approach to the bridge, a ten degree curve which was also corrected. We worked with the highway people so that when the highway was altered to approach the new highway bridge, the south rail approach was flattened to a six degree curve.

This is the rock excavation for the relocation of the track and the highway. This shows the shifted track with the new highway bridge and footing for the new retaining wall.

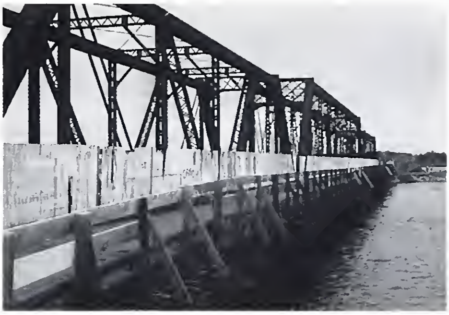
Here is the completed retaining wall with the new bridge in service and the highway shifted. You can see the new track alignment looking south.

This is the west abutment with cracked concrete and stone in poor condition. Here we are cutting away the stone and replacing it with steel grillage. Here it is completed and encased in concrete. As you can see, we did the same with the east abutment.

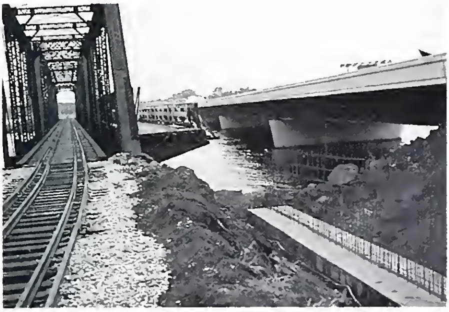
Here we are cutting away stone and installing grillage around pier No. 1. This is piers one and two completed.



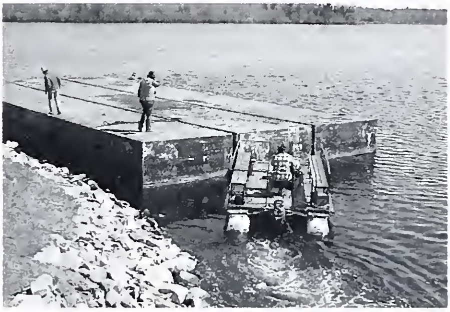
The existing three truss spans.



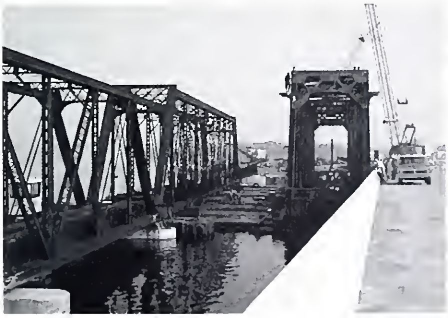
View showing single lane highway cantilevered off railroad bridge.



Track shift at south approach, new highway bridge and footing for retaining wall. Shows single lane highway.



Moving construction barge with pontoon boat and outboard motor.



View of existing truss span and new truss span which was erected on barges between highway bridge and existing railroad bridge.

Deck is removed and barges are deballasted to life the old center truss span off its bearings.

View of new span before float-in.

New truss span in place.

Here is steel H-piling for new center pier under old westerly truss span 70 foot piling for the new No. 4 pier.

Here is the cofferdam for the new No. 1 pier. New center pier under old south truss to take the new girder spans. At the same time the bridge work was carried out welded rail was being installed. Here is the fabrication of the girder and truss spans.

Here is the starting site assembly of truss on portable barges between old railroad bridge and new highway bridge. The Wisconsin River is not a navigable waterway so all work had to be performed on portable barges bolted together. Truss span would be assembled on nine 10 x 70 foot barges with a 10 x 40 foot barge at each end. The first changeout was on the weekend of June 6 and 7, 1981. Westerly truss was removed and replaced with two through girder spans. The spans were lifted into place. Ties and rail were left off to reduce weight and installed when spans were set in place.

This is getting ready for the second changeout, replacing the center truss with the new truss span that was assembled on barges between the old railroad bridge and the new highway bridge. This is blocking up under the old truss, eight 10 x 70 foot barges were placed under the old span. The barges were interlaced with other barges carrying new span.

Here is the last train over the old center span at 6:30 a.m. on July 3, 1981. Early in the morning of July 3, new truss with old center span in background. This is a view of both spans, old and new along with the early morning spectators.

After the last train had passed, the rail and ties were removed from the old span and the deck was stripped of rail and ties. The deck was removed and barges are being deballasted to lift the old truss span off its bearings.

Here they are cutting anchors. We almost had to write an environmental impact statement before we continued. Here they are cutting the anchor bolts and the bearings are removed. Here we are floating out. It was floated out at 6:44 p.m., July 3. The entire operation took 12 hours. This is a view of the old span floating out. You can see the barges interlaced with each other. Here is a view of the old span tied up to shore ready to be dismantled.

Here we are ready to float in the new span on the barges. Here is the new span in place.

Here we are ballasting barges to set the new span on bearings. At the last minute the contractor requested that the river be raised by seven inches to facilitate float-in. This turned out to be a miscalculation as the contractor was measuring from the wrong reference point. When the bridge was floated over the bearings, measurements indicated that the bridge was 15 inches above final level and then only had approximately 18 inches of free-board on the barges. So the barges started to sink. We contacted the Consolidated Paper Corporation supervisor who was the owner of the hydroelectric dam, to lower the lake. This was difficult to do because it was the fourth of July and he was on the golf course. He was finally contacted and ordered additional flow through the dam. Ballasting and jacking continued until 9:00 p.m. on July 4th and when the bridge was on the bearings, the track work was started. We had another problem in that the light plant failed and the boom light on the crane burned out so the rail installation for the 218 foot span was carried out with light from flashlights.

The first train crossed the new bridge at 2:40 a.m. on July 5. The float-in was carried out in less than two days, or a total of 44 hours.

This is a new truss span. The third changeout which involved removing the east truss span was carried out on July 18 and 19. The entire changeout process required less than five days of outages and it was not necessary to detour any trains.

All timber blocking was removed from the nine barges and all barges were free by 10:00 a.m. on July 5. Here you see the crew celebrating their accomplishment by having a couple of cans of pop.

At this time I would like to move along to our next special feature which will be introduced by Mr. Don Lewis. Don.

Mr. Lewis: Thank you, Don, and I appreciate the filler that we had there because I see a lot of people have just come in for the next two presentations that are going to be very interesting to a lot of us. First, I would like to present David Holt who will give a presentation on Flame Straightening Damaged Steel Bridges. David Holt, of the David L. Holt Company, Incorporated, Seattle, Washington, is the third generation of a family who specializes in straightening damaged structural steel members. Their family has 70 years of experience in a process pioneered by his grandfather, Joseph Holt. For the past 20 years, David has worked in this area for railroads, state highway departments, city, county and federal agencies, steel erection contractors and fabricators. Mr. Holt.

FLAME STRAIGHTENING DAMAGED STEEL BRIDGES

David L. Holt

David L. Holt Company, Inc.
Snohomish, Washington

It was 70 years ago last May that my grandfather, Joseph Holt, started to straighten steel members with the oxyacetylene torch. He had discovered while blacksmithing that when steel was kept cool, adjacent to a point at which heat was applied, the part being heated would expand outward instead of lengthwise. In other words, the heated metal followed the path of least resistance.

Grandfather had taken metallurgy in college and began experimenting with the heating effects of the torch. In 1916 he pioneered a process he called ''Structural Steel Flame Straightening'' which, three generations later, is still used to straighten bent structural steel members in bridges, cranes, buildings, machinery, spillway gates on dams and others things with a 100 percent success rate.

This afternoon I will explain what we do, how we do it, and why it works — with a very broad range of pictures of damaged railroad bridges. Through truss, deck truss, through plate girders, rolled beams, and welded plate girders — taken before, during and after repair. There will be some real attention-getting pictures of end posts, bottom chords, diagonals, hangers (or plumb posts), eye-bars, floor beams, and stringers that we have straightened by this by this process. Some were out of line by feet instead of inches, and most were straightened to within mill tolerances.

When people ask me what I do for a living, and I tell them, invariably their next questions, is ''How do they get bent?'' Well, we know on railroad bridges it is usually a derailment or over-width or over-height load. But it can also be a marine vehicle under the bridge; i.e., hitting the bottom cord, damage from fire or mishandling of new steel in the erection of a bridge. We have straightened hundreds of steel bridges in these situations.

The next question would be, ''How do you straighten them?'' Of course, this is a lot more difficult to explain, if not impossible. But in our limited time here today, I will give a brief explanation of our basic methods and principles used. I might add this is not a training course and should not be applied or tried out by just anyone. A little of this knowledge applied to damaged members can be disastrous as my father and I have witnessed in the past.

First of all, we use oxygen and acetylene for gases. The tip size is a number seven or eight, and very rarely do we ever use rosebuds for a heating tip as they dissipate the heat too much.

There are four types of heats we apply:

1. **Vee Heats** — This is the basic pattern for straightening a bend in a steel member. Place the vee heat where it is bent the most with the apex or point of the vee on the concave side and widen out to the convex side from ten degrees to 45 degrees or one-half inch to three inches, depending on the amount of bend and thickness of the metal. Start heating at the apex and move slowly back and forth to the convex side, never going back over it. In metal thicker than one inch, it will normally require heating from both sides with two torches working simultaneously.

   It must be kept clearly in mind that during the entire heat-through the whole section or member which is to be bent or straightened must be in a complete ''V'' form from one side or edge to the other, whether it is a single piece or made up of a number of pieces fabricated into one member, so that on cooling, the contraction will also be in the ''V'' form and thus, to a large extent, eliminate internal stresses.

   Sometimes a heat, though properly applied, does not pull as much as you may think it should. There may exist internal stresses which the first heat may only relieve, and a second heat will be required to do the pulling.

2. **Spot Heats** — Spot heats are used to remove bulges, dents and dishes from plates. Start heating a spot with a slow circular motion about one- half inches to two inches in diameter, on the convex side of the material to be straightened, since the heated side will upset more than the opposite side. The temperature should be kept between 800 to 900 degrees on the convex side, but only enough to burn the paint off on the concave side. Do not heat an area too large or it may cause buckling, particularly in webs under compression.
3. **Line Heats** — A line heat can be used to remove the distortion caused by a weld along a plate or straighten an accidentally bent web. On a buckled web the line heat would be on the side opposite the spot heat. Line heats are narrow, only the width of the torch flame, and made at a constant but slow speed. Flange buckles are also removed by line heats.
4. **Edge Heats** — These are used to straighten minor, smooth, gentle bends. The heat is applied to the convex edge of the member; i.e., flange, angle, etc., the full length of the bend. These heats do not pull very much, and are usually only used on very light material.

The temperature of the heats vary with the type of steel. If the type is unknown, Rockwell hardness tests or Charpy impact and tensile tests can be made. The maximum temperature should be 1200 degrees Fahrenheit for bridge steels consisting of mild steel; i.e., A36 or A7 or low alloy steels. Heating above 1200 degrees is inefficient and does not give an increase in the straightening action or contraction, and will increase the possibility of buckling. High strength steels which are quenched and tempered (i.e., A-514 and A-517) can be flame straightened without degrading steel properties. However, the steel must not be allowed to reach temperatures higher than 1000 degrees Fahrenheit. Temperature indicators or temperature sticks should be used on these types of steels or steel such as T-1, as no color will be seen under normal daylight conditions. It is always best to use a preliminary heat of 800 degrees Fahrenheit when starting to flame straighten to see what kind of movement there will be.

Peening is also a valuable aid in straightening bent members. It should be done in the unheated area (concave side) of the bent members, between the heated wedge apex and the opposite beam edge, as the beam starts to straighten after the Vee heat has been applied. Peening should be done with the flat surface of a ball peen or similar hammer. The blows should be light enough that no marking of the steel occurs. The effect is better yet if the area being peened is backed up with a heavy sledge held against the surface opposite that being peened.

During the cooling process the heated steel should be allowed to air cool. It should not be quenched with water, as non-uniform cooling may result in an uncontrolled shrinkage pattern, which may distort the member. It could also result in the steel having hard, brittle areas.

Now we have covered the types of heats, the cooling and peening process. What can be done to speed things up so we can get trains running, or remove the slow order or weight limit?

Of course, we use auxiliary forces to control or expedite the straightening process. We have two trucks completely equipped for any and all of our straightening needs; including come-alongs, hydraulic "C" clamps, hydraulic porta-powers with all lengths or size and tonnage or rams, chains, struts, welding machine, generator, magnetic drill, right down to the refrigerator, microwave and sleeper. We can have a very quick mobilization of men and equipment no matter where the job is.

As for "shoring" or jacking posts to relieve the compression or tension on a member in order to straighten it, we rarely ever need them as we do not get that large of an area hot enough to cause buckling or stretching. We don't use a piggy-back system for relieving the load on an overpass girder no matter how bad it is. And, I might add, neither Grandpa, Dad nor I have ever had a job that was not completed to the satisfaction of the customer. We have a 100 percent success rate.

I believe the reason for our success, without failures or bridges in the river in a job where you might expect them occasionally, is because we use caution. Just the right amount of heat combined with the right amount of force to reach the desired effect — a straight member.

We have 70 years of experience as a family working together in the only trade we know, structural steel flame straightening. It never ceases to amaze me what can be done with such a small torch. Just in the last few years we have saved customers hundreds of millions of dollars and time as well. Straightening bent steel is always a challenge and each job is different. There are many advantages of straightening versus replacement:

1. Speed of repair.
2. Cost effective.
3. Fewer traffic disruptions.
4. Local forces used.

Whenever there has been damage to a steel member, one of three decisions must be made:

1. Do nothing.
2. Repair the member.
3. Replace the member.

Hopefully, we have broadened the option of number two for you — repair the member.

Effect of Steel Properties

There is ample evidence that properly executed flame straightening does not significantly degrade mild steel or low alloy bridge steels. Flame straightening has been successfully accomplished for more than 70 years (Holt[2] and Harrison[3].) Harrison's tests of mild steel flat bars showed insignificant increases in Rockwell hardness, virtually no change in ultimate strength, and an unexplainable increase in impact energy measured in ft.-lb. (Rothman, et.al.[4]) tests of A-441 steel showed slightly higher transition temperatures, but the change was not considered significant. Yield and tensile strengths were unchanged, elongation in two inch was reduced from 34.5 to 28.0. The specification requirement for elongation was 18.0 (ASTM). Normalized steel A-537-A showed no loss in properties due to flame straightening. (Pattee et. al[5]) state that low-alloy steels with yield strengths ranging from about 45,000 to 75,000 psi can be heated to conventional flame-straightening temperatures (approximately 1,100 to 1,200 degrees Fahrenehit) without significantly affecting their mechanical properties. Pattee et. al.[6] tests concluded that flame straightening of A441 is an acceptable procedure that does not give an adverse effect on material properties. Holt[7] states that flame straightening will improve material properties, including Charpy impact energy, with the exception of an insignificant reduction in ultimate tensile strength.

The conclusions of recent studies indicate that even heat-treated steels can be flame straightened without material degradation if appropriate maximum temperatures and exposure times are observed. The most recent literature acknowledges that flame straightening will not degrade A-514 and A-517 steels provided heating temperatures are kept below the tempering temperature of 1,150 degrees Fahrenheit. Mishler et. al.[8] notes that experimental data show that by controlling flame straightening to limit the surface temperature to 1,050 degrees Fahrenheit, no significant reduction in strength or toughness occurred. Due to their thermal strain behavior, these steels are more difficult to straighten. The plastic strain of A-514 and A-517 steels heated to 1,050 degrees Fahrenheit is less than 60 percent of the plastic strain of A-36 steel heated to 1,200 degrees (calculated from Holt[7]). The heated element is assumed to be perfectly confined along one axis.

Flame Straightening — Maximum Temperatures

For most steels, 1,200 degrees Fahrenheit temperature gives maximum thermal upsetting without any detrimental effects on the metallic structure of the steel. Holt[7] recommends a maximum temperature of 1,200 degrees Fahrenheit for all steels in normalized or annealed condition, and the maximum temperature for quenched and tempered steels (ASTM A-514 and A-517) shall not exceed the tempering temperature. Pattee et. al[5] state that low-alloy steels with yield strengths ranging from about 45,000 to 75,000 psi used in the as-rolled or normalized condition can be heated to conventional flame straightening temperatures (1,100 to 1,200 degrees Fahrenheit) without significantly affecting their mechanical properties. Pattee et. al[6] notes that the study results show that the widespread use of flame straightening of A-441 steel is an acceptable procedure and that flame straightening of A-441 is permissible at temperatures up to 1,400 degrees Fahrenheit. Rothman et. al[4] notes that the study results showed that normalized A-537A could be flame straightened at temperatures of 1,300 degrees Fahrenheit with no loss in steel properties.

Review of these and other literature indicates that 1,200 degrees Fahrenheit should be the maximum flame straightening temperature. Heating above this temperature may result in undesirable steel properties. Quenched and tempered steels such as A-514 and A-517 shall not be heated above 1,050 degrees Fahrenheit, which is below the tempering temperature of 1,150 degrees Fahrenheit.

Footnotes

[1] Holt, J. E., "Contraction as a Friend in Need." Typed and duplicated in U.S.A. (Copyright, 1938).

[2] Holt, J. E., "Flame Straightening: A Friend in Need". Welding Eng. (October 1955), pp 44-46.

[3] Harrison, H. L., "Straightening Structural Members in Place". Welding J. (May 1951).

[4] Rothman, R. L., and Monroe, R. E., "Effect of Temperature and Strain upon Ship Steels". Ship Structure Committee Report SSC-235 (1973).

[5] Pattee, H. E., Evans, R. M., and Monroe, R. E., "Flame Straightening and Its Effect on Base Metal Properties". Ship Structure Committee Report SSC-198 (August 1969).

[6] Pattee, H. E., Evans, R. M., and Monroe, R. E., "Effect of Flame and Mechanical Straightening on Material Properties of Weldments". Ship Structure Committee Report SSC-207 (1970).

[7] Holt, R. E., "Primary Concepts for Flame Bending". Welding J. (June 1971).

[8] Mishler, H. W., and Leis, B. N., "Evaluation of Repair Techniques for Damaged Steel Bridge Members". NCHRP Project 12-17 (May 1981).

[9] Shanafelt, G. O. and Horn, W. B., "Guidelines for Evaluation and Repair of Damaged Steel Bridge Members". (June 1984).

Are there any questions?

Fred Day, Conrail: About 30 years ago I read an article in the Engineering News Record about how to straighten these, and it might have been by your grandfather, by applying the heat in a triangular method, moving the torch back and forth. I tried it a couple of times and it seemed to work pretty well. We had a tornado come up the river in Monticello, Indiana, about 20 years ago and it just picked the 120 foot girders right off their piers on a single track railroad and threw them upstream about 50 feet. The ends were bent; we had to replace two out of three spans and I spent about four days with the torches trying to straighten out a kink in the end of the 120 foot girder and it wouldn't work. And I figured finally that the reason was because it was made up of the webs and two angles top to bottom and a couple of cover plates, one or two on the top and I figured the heat wasn't getting evenly distributed. Now, can you tell me what was wrong with what I was doing that it wouldn't straighten out?

Mr. Holt: Well, you have to use force on the end of girders. I don't really know what you did but you have to use force.

You have to make sure that your heat does soak all the way through. You have to sink your heat in and it is hard to go through different thicknesses. Sometime we will knock off the rivets and take it one layer at a time. So you do have to get it up to about 1,200 degrees.

Mr. Day: How do you tell where you have 800, 900 or 1,200? But I can't tell if it is cherry red, white or yellow.

Mr. Holt: Well, usually you can't see it in color. But when it gets to cherry red, so that if you took your torch away, the color will fade out that is about between 1,100 and 1,200 right there.

Any other questions? If not, thank you.

Mr. Lewis: Thank you, David. That was really interesting. Our other speaker on repairing steel members is Mr. George Krupa. Mr. Krupa is manager of the structures group in the midwest region of Delon Hampton and Associates, a position he has held since 1985. Prior to that he worked with the Illinois Central Gulf Railroad. During his 15 years with the Illinois Central Gulf he held positions of student engineer, engineer inspector, structural designer, planning and scheduling engineer, project engineer, senior staff designer and senior structural designer. George is a registered professional engineer in the State of Illinois and holds a Bachelor of Science and a Master of Science degree in civil engineering from the Illinois Institute of Technology. He is a member of the American Society of Civil Engineers, American Railway Bridge and Building Association and the American Railway Engineering Association, where he is also a member on the Concrete Bridge Committee. At this time I would like to present George Krupa.

REPAIR OF STEEL TRUSSES

George K. Krupa

Delon Hampton and Associates

Introduction

Repair of steel trusses is a very broad topic. Because of the limited time available, only truss straightening and the shortening, straightening, reinforcing and replacement of individual truss members will be discussed. Most of these techniques can also be adapted to other types of steel spans. My discussion will mainly consist of examples of the application of these techniques.

General

Before we discuss techniques, a short discussion of repairs in general is appropriate. The first decision you will face after a span is damaged is whether to repair or replace the entire span. As part of this decision you will have to consider the repair or replacement of individual span components or truss members. The decision to repair or replace an entire span should include a consideration of the following:

(a) Severity of the damage
(b) General condition of the span
(c) Capacity of the span
(d) Importance of the route served by the span
(e) Age of the span
(f) Cost and availability of detour routes
(g) Time necessary to design and fabricate repair parts or a replacement span
(h) Relative cost of repair versus replacement

Once the decision to repair a span is made you can consider the repair or replacement of individual span components or truss members. These decisions should be based on a number of factors which can include:

(a) Severity of damage
(b) General condition of a member prior to being damaged
(c) Time necessary to design and fabricate repair or replacement steel
(d) Relative cost of repair versus replacement

Some members will be damaged so slightly that they can remain in service. While others will be damaged beyond the point of being repaired. Some members although repairable, will be in such poor condition that their repair is not justified. Conversely, a span in poor condition nearing the time of its replacement may be able to continue in service for a short time with just minor repairs. The time necessary to fabricate repair or replacement steel will vary greatly depending on the type of member being considered and the amount of repairs required. The availability of funds and the relative costs to repair or replace a member could favor either option. Secondary members such as bracing will usually be less expensive to replace, while primary members will often be more economical to repair.

Truss Straightening

This truss span was struck by a barge on its upstream side just to the left of panel point two. In addition to suffering damage to many of its members the truss itself was knocked out of alignment. Panel point two was moved downstream one foot, three and three-eighths inches. The other panel points were moved proportionally. The truss was in relatively good condition so repairing it was feasible. The straightening of the truss span posed a particularly interesting problem. It was decided to jack the span back into alignment. To do this something was needed to jack against. The solution chosen was to erect a strut horizontally from panel point two on the downstream truss and secure the end away from the span with cables attached to the bearing assemblies of the upstream truss. In other words, the truss span was jacked against itself.

The jacking strut was nicknamed the ''Klondike Kicker''. Here you can see the end away from the span. Please note the large shackles used to attach the main cables. The turnbuckle on the top was attached via a cable to the top chord of the downstream truss and supported the end of the strut away from the span.

This was the frame used to attach the strut to panel point two. The strut was erected by threading it out through the downstream truss and slowly lowering it into position. To facilitiate the realignment of the span, its lateral bracing and stringer to floor beam connections were loosened. With the strut fully down, the cables to the bearing assemblies were strung. To jack the span, a 100 ton hydraulic jack was placed in the frame at panel point two and pressure applied. The jacking went fairly smoothly and panel point two was brought back to within one and one-quarter inches of proper alignment.

The only hitch was that panel point three did not come back into alignment as much as expected. To correct this problem, additional jacking struts were erected from panel points two and four on the downstream truss to panel point three on the upstream truss. These struts were secured to the bridge deck and attached to the panel points with custom bearing assemblies. As pressure was applied to the jacks, panel point three moved upstream relative to panel points two and four. Only a limited amount of pressure could be applied as the truss members at panel points two and four started to bend. This deformation was only elastic and disappeared when the pressure was released. This did however, limit the amount panel point three could be moved. In the end, it was brought back to within 15/16 of an inch of proper alignment.

Flame Shortening and Flame Straightening

Particularly useful truss repair techniques are flame shortening and flame straightening. Here we have the bottom chord of a truss which was struck by a barge. The truss was relatively old, having been built in 1897, but it was in good condition and the decision was made to repair it instead of replace it. The I-bars which comprise the bottom chord measure one and 7/16 inches by six inches. A safety stringer is normally located immediately to the left of the I-bars, but was removed to facilitate their repair. The problem was to repair this damage in a cost effective and timely manner. The solution chosen was a combination of flame shortening and flame straightening.

The equipment needed was relatively simple: a flame shortening device; heating torches; steel wedges; oak blocks and wedges; hydraulic jacks; and large wrenches. First, let us review the flame shortening operation. The clamping plates were attached to an I-bar with bolts and the pulling rods put in place and secured with keyed pins, as this was a horizontal application, only the bottom rod needed to be secured. With installation of the device complete, the first step was tightening the bolts on the pulling rods. This compressed the area of the I-bar between the clamping plates and tensioned the remainder of the I-bar. Next, a portion of the I-bar between the clamping plates was heated until it started to deform. Then the pulling rods were tightened again and the heating stopped. Lastly, the heated area was cooled using wet rags. The I-bars needed to be cooled down quickly to achieve a good production rate, but not so quickly that the metal was adversely effected. One cycle of the flame shortening operation took approximately 30 minutes to complete and shortened an I-bar by approximately one-quarter of an inch. The second part of the operation was the flame straightening. In addition to being elongated the I-bars were badly bent. To straighten the bent portions, they were first heated and then forced back towards alignment.

The most commonly used method to apply force to a bar was a hydraulic jack. The second method used was a steel wedge. This technique was used in areas where a hydraulic jack could not fit. Once again the areas heated were cooled with wet rags between heatings. This was a typical set-up. Please note the oak blocks and wedges for the jack to operate against, and the four man crew needed to perform the work. Here we see both jacking and wedging going on concurrently. It must be remembered that flame straightening was done simultaneously with the flame shortening. There was always a flame shortening operation going on to keep the portion of the I-bar being straightened in tension. Both flame shortening and flame straightening are gradual operations taking many applications to remove substantial deformation. This next set of four slides will show the partial removal of a major kink. Approximately a dozen heatings were needed to partially remove this one kind. The overall strategy was to straighten the outermost I-bar first and then work towards the inside. It was necessary to place a strut between the floor beams located at the ends of the panel being worked on to control shortening of the panel. Once all the I-bars were straight they were then tightened to equalize the tension in them. The next two slides are of a typical area where flame shortening was performed. Please note the upset areas at approximately three inch intervals. This is the finished job with the safety stringer replaced.

Member Straightening

Flame shortening and flame straightening are not the only techniques available to straighten a truss member. The members on the right side of the screen had a minor bend near its middle. It was decided that this bend could be pulled out of the member. Of course, portions of the member were heated to control the operation. Here a pair of braces are being installed to provide a rigid anchorage to pull from. Next cables and a come-along were strung and the member pulled back into alignment. Heat was applied in the area of greatest deformation. This is the straightened member.

Member Replacement

Sometimes it was less expensive and/or quicker to replace rather than repair a damaged truss member. Virtually any type of truss member from main member to bracket can be replaced. Here we see on the right side of the screen two main members which were replaced. Before a main member can be removed, the truss must be braced or supported to allow for the temporary absence of the member.

In this case, the vertical struts were the braces, while the diagonal struts were used to jack the truss back into its original shape. During the accident that damaged this truss span, the bottom chord was moved relative to the top chord, thus causing the deformation of the members being replaced. This particular replacement operation was performed without the direct assistance of a crane. This was necessary because the bracing between the top chords of the trusses and the diagonal jacking struts were in the way. A small hoist secured to the bridge deck and block and tackle were used. A shop fabricated replacement member was spliced on to the ends of the original member which had been left in place.

A relatively simple member to replace was a floor beam as it required no temporary bracing. The floor beam to stringer connections were broken, the old floor beam removed, and the new floor beam installed. Often, as was the case here, the old floor beam had to be cut in half before it could be removed and the new floor beam cut and then spliced after it was installed, due to the confined working area. With bottom lateral bracing it was easier to order stock angles and make custom brackets in the field from plates. The two were then field fitted and drilled. Lateral bracing to gusset plate connections were also drilled in the field. Top lateral bracing was usually easier to replace than bottom bracing as they were lighter and there was no deck in the way. Here you can see a small jib we added to the crane boom to facilitate getting the bracing above the top chord. Again stock angles were used and all holes for connection were drilled in the field. Here is an anchor bolt that was bent when a truss span was moved laterally during a barge strike. Instead of removing the entire anchor bolt, it was cut off and a new bolt welded onto the stub. During an accident the main parts of the bottom chord of the truss shown here moved relative to each other. This movement stretched half the lacing bars and buckled the other half without damaging the main parts. Repairs consisted of replacement of the buckled lacing bars and all the rivets with high strength bolts.

Miscellaneous

The last group of repair techniques are the miscellaneous ones. Here we see the drive pinion of a swing span. Its support bracket had cracked where it joined the ring girder. This was a recurring problem and had been repaired by welding on previous occasions. This time, in addition to welding the original plate, the support bracket was reinforced by the addition of new angles and plates. This is a reinforcing plate on the web of an end floor beam adjacent to a stringer. The floor beam web was bent during an accident and instead of straightening it, a plate was placed over it to reinforce it. Lastly, here is a turnbuckle located on a counter. It was used to tighten the counter and supply tension for a flame straightening operation.

Closing

In closing, I would like to say that the repair or replacement of individual truss members is often a viable alternative to replacement of the entire truss and should be seriously considered the next time you have a damaged steel truss.

Thank you.

President Bessey: Thank you very much, Mr. Krupa and Mr. Holt. Both presentations were very interesting. I want to bring to your attention that we do have copies of the special subject reports at the back of the room and there is no extra charge! We have reached the point where if there are no special announcements, we will adjourn.

Be sure to meet with your friends tonight and enjoy the buffet and entertainment to be provided by REMSA. This meeting is adjourned until the joint session at 8:30 tomorrow morning in the Grand Ballroom on the fourth floor. Thank you very much.

WEDNESDAY MORNING JOINT SESSION

September 17, 1986

President Moorman: Ladies and gentlemen, we will now call this final Joint Session to order. Our thanks to REMSA for the wonderful reception last night. As of 8:00 a.m. this morning, our registration stood as follows: 160 Roadmasters; 70 B&B; 143 Associates, 154 Guests, 56 Ladies, for a total of 583. This compares with a total of 673 at this time at our last Chicago conference which was in 1984. So we are off about 100. At this time I would like to recognize the outgoing directors of the Roadmasters' Association. I know one of them couldn't be here, Mr. Ken Welch of the Union Pacific. I would like to call up Jerry Wood and Al Matte. Al, on behalf of the Board of Directors of the Roadmasters Association I would like to present this fine plaque to you and thank you for your years of service with the Association. Thank you, Al. And, the same thing to you, Jerry. We appreciate your years of service with the Roadmasters. And now at this time I would like to turn the podium over to President Bessey.

President Bessey: I see everyone had a good time last night and our heartfelt thank you to REMSA for a great party. The By-Laws of our Association dictate that I must present a report of the general condition of our association. I failed to do this yesterday during our business session so, with the Roadmasters' indulgence, I would like to do this now.

Our membership has dropped slightly over the last year. However, our financial situation has improved one-hundred fold. We have gone from a near bankrupt situation two years ago to a very solvent position this year. This, of course, is due in part to increasing the dues and registration fee. However, the greatest contribution to our healthy financial situation was the decision to have our office staff, with the help of the membership, handle the advertising for the Proceedings. Just staying at our present level means that we have a 35 percent increase in our advertising income. You heard me say "with the help of the membership" because it will be up to you and me and all of us to make this process work. If you have knowledge of some company who should be advertising in the Proceedings, get this information to Pat or to one of the directors so they can contact these people, because we are doing our own advertising. We are our own advertising agency.

I would also like to ask your help to further improve the B&B Association's situation by first, paying your dues promptly and second, to improve our membership count. Urge all of your fellow workers and associates who are eligible for membership to join the Association. That concludes the President's Report that I failed to do yesterday.

Our association elects three members each year to serve as directors, just as we did this year. So at this time I would like to present plaques to the three outgoing directors. As I call your name, please come forward.

Byron Burns. I present this plaque to you as a symbol of our appreciation for serving your association. Byron has been captain of the Ladies Activities. You did a great job and also congratulations on your elevation to Junior Vice President.

John Horney. I present this plaque to you as a symbol of our appreciation for serving your association. John has taken on the chairmanship of many committees, worked on special subjects and now has accepted the responsibility of serving one more year as director to fill an unexpired term.

Bill Semioli. Bill worked on membership and guided our moves in advertising and many other tasks. It is nice to have the "Press" on your team.

At this time I would like to ask Don Lewis to introduce our next speaker

Mr. Lewis: Thank you, President Bessey. We were to have two speakers this morning on clearance measurement technology. However, of the people from SRS, Mr. Otteborn was called away and Bill Morehead, who represents SRS, has a back injury and he cannot travel. So what we are going to do is have Mr. Schoville, Union Pacific's project director of the laser car, give his presentation. After the question and answer period we will show a slide presentation made by the Portland Cement Association on Prestressed Concrete Railroad Ties. At this time I would like to present Mr. Schoville who will give us information about Union Pacific's laser car. Mr. Schoville.

CLEARANCE MEASUREMENT TECHNOLOGY

Perly A. Schoville

Project Director
Union Pacific Railroad

Mr. Schoville: Good morning. I consider it a privilege to be here. You people are a very integral part of any railroad's clearance program. I have a short slide presentation which will show the how's and wherefore's of the Union Pacific's laser car. The presentation will give you a general picture of the vehicle's capability and history and how it works. If you have any questions that don't get answered during the format question and answer period, I will be available during break.

Before I start, however, I would like to give you an appreciation for the importance of good clearance data. Any industry that is land locked is generally restricted to shipping any high and wide heavy load by rail. Air moves are expensive and hampered by weight limitations. Highways are capable of greater weights than air moves but are hampered by low overpasses, traffic, and public regulations. Thus, a privately owned railroad is generally the accepted mode of transportation. Cars have been built that range from a 36-axle operator controlled split apart Shnable car to a well-hole flat. Manufacturers, many times, will design module units and sizes for vessels, transformers, even airplanes to the dimensions that can be handled by a railroad. Obviously in today's competitive world it behooves us to accommodate these shippers whenever possible. It is worth noting that these commodities are very expensive and must be handled with the utmost care and safety. This is where we, you and I, as engineering personnel enter in. Different loads have different dimensions and are loaded on cars with varying swing-out and swing-in dimensions on curves. This results in each load being handled separately. If ballast is raised under an overhead or through a tunnel or bridge, the structure should be remeasured for clearances. Even curve realignment can cause an obstruction to be remeasured. Using the double- stacked trains as an example of the importance of track alignment please note that a one-half inch change in cross-level will result in two inches less clearance at the top corner of the smallest double-stacker. We at Union Pacific will clear a load at 70 miles per hour with six inches clearance while less is restricted, so good data is important. It is the field's responsibility to make sure the proper people are notified of changes to the clearance obstruction in either direction.

The clearance problem is not a new one and there are many modes of solution. Perhaps the most common is to manually measure the blasted thing and traditionally this is how it is accomplished. Usually individuals visually pick out what appears close and they measure it. However, a rock-lined tunnel on a curve leaves this method unacceptable. As failures occur a history is developed and these areas are defined and measurements obtained and used in subsequent handling. However, as clearances are improved the changes rarely get revised. Consequently, railroads may be rejecting loads that otherwise could be handled. Another problem is the amount of time and effort required to maintain good data. By the time data is measured and new diagrams are produced and ready for use, the alignment has again caused a change. At Union Pacific we experimented with many different clearance measurement modes, from feeler cars to photo cars to what we have today. The vehicle was built by Union Pacific using both in-house and outside personnel. The vehicle is a 1983 Chevrolet stepvan built by Utilimaster. All equipment is powered by a 6000 watt Onan generator. The car has four main modules, speed control and milepost counter, computer and software, scanner and translation stage, and the geodolite laser with its optics. The speed control and milepost counter regulate the speed and location during moving measurements and is especially helpful for doing 3-D modeling. The milepost counter gives a digital readout in either feet or thousandths of a mile independent of the computer. Both the counter and computer read the same signal; however, if the computer should need re-booting or shut down or if a different program is run then the milepost counter will continue to run. The counter will run in either direction, forward or reverse. The speed control will regulate the speed of the vehicle down to a tenth of a mile per hour.

The computer is a DEC PDP/03 using eight-inch floppy drives. Although very antiquated it serves its purpose for this application. This system will most likely be replaced. All software is written in Fortran or machine language. The data is ascii format and written to eight inch floppy disks which is a very cheap medium. These floppies are the weak link in the system and care is taken to daily back up data.

The scanner directs the beam at any one of 2048 positions in a circular arc. Both the scanner and translation stage are computer controlled. Generally, we collect 300 data points between 25 and 335 degrees as shown here. This gives us a data point approximately every degree. Since we are only interested in the minimum value, the software uses an array. An example would be at 90 degrees on the first revolution the laser measures 7.92′; the next revolution it says 7.85′; then 7.92 would be replaced by 7.85, if the next reading were 8.05 then 7.85 would remain. The result is that for a particular structure only 300 data points are stored thereby greatly reducing the amount of data collected. One must be careful when measuring a tunnel for 3-D because all data is collected and stored including Z-data and it would take a boxcar to carry the floppies. Typically one full day's work will fit on one floppy.

The geodolite and its optics are the heart of the operation. The geodolite is manufactured by Spectra-Physics originally for measuring wave heights in the ocean during storms, or ice flows in the Arctic, and deformation of dams during load and can measure distances of 40 miles with an accuracy of one-eighth inch. Although this slide insinuates the time is measured it is actually the area under a sine wave that is measured. Modifications to the optics allowed us to measure over distances more suited to railroad applications. The laser is harmless and only emits 5mw which qualifies it as a Class IIIB product. When focused the spot size is just under 3mm. Although the laser has an accuracy of one-eighth inch due to software and gauge limitations, we feel we get approximately plus or minus one-half inch. One unique feature is that every scan of the railhead is profiled, the computer receives four to five data points on each head, the rail gauge is then known and the plane normal to the rail. Since the scan head will rarely fall on this line, subsequent trigonometry is used to calculate each data point with respect to the rail rather than with respect to the scan head. This is done by software upon each revolution.

Using 300 data points per revolution we get a data point every three-eighths inch on a ten foot radius. Data can be plotted on the car using a H.P. 8-1/2″ x 11″ plotter as shown in your handout. This is generally used as a check or given to field forces when doing tunnel enlargement. We opened up numerous tunnels where the car would run through a tunnel, mark the area for work, show the results and check the finished product on site and in minutes. Usually this data is stored on a floppy disk, printed and taken to headquarters to be dumped into our CAD system for editing. To get it this far takes approximately 10 to 20 minutes. These slides show 10 foot composites on curves and 100 to 500 feet for tangent. Each scan and obstruction can be isolated and viewed. Notes and maps are added and structures layered upon each other to represent territories between terminals or branches. I have a finished product showing a typical area here. The operator manipulates the CAD system to produce desired plots so that the finished product is readable. Since the clearance data collection is automated and data is digital our next step is computerized clearing of loads. Of course, the motivating reason for such accuracy is fear or translated into railroad terminology — safety. Are there any questions?

Dave Staplin, CSX: How long did it take you to develop that system?

Mr. Schoville: Well, we went through quite a process in developing that. I'm not trying to skirt the issue but we first developed it inside a suburban wagon and it took us about two years. Then someone conveniently rolled the car for us and at that time we decided to put everything into a stepvan. The laser is temperature sensitive. If you have a change in outside temperature of 20 degrees you need to retune the laser itself, so when we bought the new car we took in some of those modifications. So it took us probably a good three or four years to get it to where it is right now.

Gene Schubel, BN: Is there any calibration necessary with this or is it self-calibrating?

Mr. Schoville: That's a good question. I would like to use the chalkboard if I can to answer that. As I mentioned earlier in between the rails there is one on each scan computerized to do all of its calculations. Well, the laser doesn't really know the difference when it is on what we call the 20-foot channel. It doesn't know the difference between one foot, 21 feet, 41 feet, etc. So we can take care of some of that through software. However, everything is done by analog signal not digital. Fortunately, the analog signal runs between minus five volts and plus five volts, which is a range of 10, which is digital. So even though it is an analog signal, we essentially get digital readouts. What happens is we have put a bar that is affixed to the car in the back and this bar is a known distance from the scanner. That distance I think is 6.49 feet I'm not sure, but for our purposes, that is good enough. So each time around the laser hits this bar and now it uses 6.49 on each reading as the distance for that particular signal. So that is how the laser actually calibrates itself on each scan. Now if on one scan it came down here and it got something like two volts which would give you an even zero then flag for the operators and say "Hey, something is going on here. A man just landed on the bar or something." That is very, very infrequent though. In fact I can't ever remember it happening. It is a flag though that the guy might have his shutter up on the laser and he needs to stop and open up the shutter and make sure that everything is in operating condition. But once he is moving, it is calibrated on each scan.

Mr. Schubel: Can he get double track?

Mr. Schoville: Yes he can. Say you have a second track over here and you want to know what track centers are? Is that your question essentially? He can do that, yes. You have to go through what is called the 50-foot range for doing that. At the 50-foot range you have an accuracy of about plus or minus an inch rather than plus or minus a half-inch. So you do give up something in accuracy. But generally that is good enough for our purposes.

Member: What is your procedure for maintaining this data base?

Mr. Schoville: We are still in the process of getting our first one done. We've measured numerous areas up in our northwest and what we call our Feather River area out on the Western Pacific trackage. The problem we ran into is that we always end up with so many special requests for the car that it is difficult for us to get our program. We have used the car for the Burlington Northern and D&RG; we have used it extensively for Mr. Horney's group for helping enlarge tunnels for double-stack traffic. What generally will happen is that we will get up in some area and somebody from the VPO's office will determine that there is some critical reason that we need clearances obtained in another area. My answer to that question is that once we obtain the data we plan on following the codes wherever they go through a structure and change it. Obviously if it is an open deck truss, chances are it is not going to change very much. But we are finding vast differences from hand-measured truss data than that obtained by the car. Generally, what we are finding is that we are getting the clearances on the sides. A guy goes out and measures it. He's a surveyor and he says "Well, I know those guys back in Omaha are going to take this as gospel — so I'm going to add a little flex out to here to make sure that nothing happens". It may not be much but by the time it gets back to us we add factors too and pretty soon you have a hole about this big that you are trying to pull stuff through. It is important that we have accurate information and on those types of structures one time through is good enough. On the overhead we are finding out that typically they have measured a couple of inches below the bridge lines and draw whatever it looked like on the bridge drawings to make it fit those dimensions. So we are hoping this will improve our clearances immensely. Eventually, we will go back and measure all of the ballast structures. Some of this stuff can be handled by the roadmasters but it is just that on an overpass straight across we have the design of how it looks and if it is tangent track and if they raise the track six inches and let us know then we can update our data without sending the car. Any other questions?

Member: Do you have to download off the track system to clear your loads?

Mr. Schoville: Right now we plot off the CAD system the samples of the diagrams that we use in the back. I think I know what you are getting at, and that is a good question. We are automating the clearance of the collection process but we are still handclearing the loads. That is our next step, to automate the clearing on the loads — to take that data from the CAD system. Our plan right now is to use the CAD system as to automating that method. We feel there are certain benefits from having engineering people handle that kind of information rather than raw feeding it to an IBM system and letting transportation handle it. Although that is a possibility as well. That is all it has to format so it can go into the IBM very easily. In fact, at the BN we did that. Any other questions? If not, thank you.

Mr. Lewis: Thank you, Perly. That was very interesting. We are now going to have a 20-minute film from the Portland Cement Association on Prestressed Concrete Railroad Ties.

PRESTRESSED CONCRETE RAILROAD TIES

This presentation has been developed by the Portland Cement Association in cooperation with the Prestressed Concrete Institute and the Canadian Prestressed Concrete Institute

Prestressed concrete ties have become a practical part of the track system for a growing number of North American railroads. To understand this development, the following questions must be answered.

What is a prestressed concrete tie?

Why are prestressed concrete ties specified?

Where are prestressed concrete ties used?

How are prestressed concrete ties installed?

The answers to these four basic questions should provide a good foundation for understanding prestressed ties. The prestressed concrete tie consists of a basically rectangular piece of concrete, prestressed to a compressive state. It is fitted with hardware to hold the rail in place as an integral part of the system, which includes subballast, ballast, tie fastener, and rail. The hardware typically used to attach the rail to the tie consists of a tie pad between the rail and the tie; insulators between the rail, shoulder, and clip to insulate the rail from the tie; shoulders embedded in the tie; and spring clips inserted in the shoulders to hold the rail in place. The tie pad also dampens vibrations and impact loads transmitted between the rail and ballast.

Why are prestressed ties specified? The reasons are both technical and economic, the two having a close relationship.

The technical reasons as listed can be observed and quantitifed. They are:

1. Increased track modulus
2. Increased lateral stability
3. Excellent gauge control
4. Less truck hunting
5. Smooth ride
6. Predetermined and engineered standards
7. Easier transposition of rail
8. No plate cutting
9. No spike kill
10. Increased spacing.

The economic benefits of concrete ties include life-cycle cost and operating benefits resulting from:

1. Reduced cost of maintenance of line, surface and gauge
2. Reduced time required for maintenance
3. Increased track time available for running revenue-producing trains
4. Increased tie life
5. Improved rail life
6. Reduced fuel consumption
7. Fewer ties required per mile
8. Reduced cost of hardware per mile of track

While the final decision to use prestressed concrete ties should be based on each railroad's operation, some general guidelines are available from both theoretical and actual experience.

The value of concrete ties on heavy-traffic curved track has been established by the Canadian National Railroad. CN has reduced new rail relay by an average of 22 percent during a time of increased tonnage and escalating use of heavy axle cars. With concrete ties, Canadian National has also been able to eliminate one complete lift-and-surfacing cycle per five-year period, as compared with its pre-concrete-tie track structure. In addition, CN credits a 2.3 percent reduction in fuel consumption to track with concrete ties.

While these operating benefits give a general idea of what other users might expect, there are specific benefits that should be included in an economic analysis. These are: fewer ties per mile, and reduced track hardware per mile. The increased track time available for running revenue-producing trains is an additional benefit for both traffic management and maintenance, going beyond bottom-line economics in the extra flexibility it allows in scheduling.

The next question is "Where are prestressed concrete ties used?" While prestressed concrete ties can be used to build track anywhere, there are certain special applications where the technical and economic benefits have proven especially worthwhile. These applications are:

Track built to handle heavy-freight trains in curved territory. Experience in this area covers almost the complete list of technical and economic considerations

High-speed passenger trains where comfort and safety are prime considerations;

For transit operations, track quality must be maintained at a high level for rider comfort and tight train schedules. Experience has shown that prestressed concrete ties can provide the necessary track quality within the limited maintenance times available.

Light-rail transit (LRT) is developing again in North America. Concrete ties meet light-rail transit's maintenance needs while adding to the esthetics of the track environment.

Industrial track and sidings especially benefit from the reduced maintenance requirements of prestressed-tie track.

New construction lends itself readily to the use of concrete ties.

In summarizing the "where" of prestressed tie track, its ability to perform under extreme environmental conditions is worthy of mention.

A quick review of the introduction of prestressed concrete ties to North America starts in Europe. In the foreground of this slide from British Rail is one of the original installations in Great Britain. It uses bullhead rail and chairs with jointed rail, adjacent to one of its newest installations, with spring fasteners and shoulders cast into the tie with continuous welded rail. These installations represent over 40 years of concrete tie use by a single railroad.

Chessie System Railroads have been constructing test sections since 1968. There are now four separate test sections utilizing six different prestressed tie designs and a variety of fastening systems. Seaboard Coast Line, now a partner with Chessie in the CSX System, has also used prestressed concrete ties for many years.

The Norfolk and Western Railroad constructed a test track in 1974 that carries 45 million gross tons annually. Other successful test installations include the Santa Fe's installation at Leeds, Illinois, the Canadian Pacific's installation at Beavermouth, British Columbia. The Florida East Coast Railroad was the first regular user of prestressed ties in North America. More than 250 of FEC's 396 miles of mainline track are now constructed with prestressed concrete ties. The Kansas City Southern Railroad, which has a regular installation program, is another long-term user of prestressed concrete ties. Amtrak chose concrete ties for installation on 400 miles of the Northeast Corridor between Boston, New York, and Washington. This track is unique, as it carries both heavy freight and high-speed passenger trains.

Canadian National started experimenting with concrete ties in the 1960's. It now has established a criterion for inserting concrete ties in mainline track with curvature of two degrees or greater and tonnage of at least 20 million gross tons per annum. The CN system also uses continuous-welded rail and an improved ballast section. This track structure has been installed on over 470 miles of mainline track.

While various railroads have been using concrete ties as test installations or in scheduled renewal and upgrading, the U. S. Department of Transportation at its Facility for Accelerated Service Testing (FAST) track in Pueblo, Colorado, has subjected a test section of prestressed concrete ties to over 600 million gross tons of accelerated testing, equivalent to over 15 years of heavy-duty mainline service. In addition, laboratory procedures for static and dynamic testing were formulated to aid the development of prestressed concrete ties. The American Association of Railroads initiated this effort with the American Railway Engineering Association to develop guide specifications. Laboratory tests that have proved valuable are the rail-seat positive repeated-load test and the simulated track test. The various dynamic repeated-load tests simulate loadings as recorded during actual field tests.

Since prestressed-tie track consists of more than just ties, the fastener has also undergone much testing and development in recent years. The fastener must accommodate horizontal, vertical, and longitudinal loads.

The growth of the prestressed concrete tie industry has required the development of efficient production facilities. Such facilities are of two types: they are part of a larger prestressing plant, or they are a separate, specialized operation. The newest high-production operations use the long-bed casting method. The production operation includes placing the fastening hardware, pulling and stressing the tendons, placing and vibrating the concrete, covering and curing the concrete, cutting the prestressing wire, and removing the ties from the forms. As in any large production process, specialized equipment has been developed to keep labor costs down.

AREA specifications include extensive production quality control testing, such as this rail-seat positive load test, and this rail-seat configuration and insert location check. These are carried out on one tie per 200 of the day's production run.

Finally, how are prestressed concrete ties installed? Like the ties themselves, equipment to handle and install ties has undergone considerable development. While specialized equipment is of particular interest, standard maintenance-of-way equipment has been used to install and maintain concrete-tie track. The installation of concrete-tie track is a cost consideration that varies with the method used. For small sections, unsophisticated procedures and modified construction equipment has been satisfactory. As the size of jobs has increased, the introduction of more mechanization to reduce labor has led to development of such equipment as the tie-layer used to construct the Black Mesa and Lake Powell Railroad, the Geismar gantry system, which was used on early installations, and the panel system. This mechanization has led to the use of an automated track-laying machine consisting of special tie cars. A gantry system riding on the tie cars unloads the ties and feeds the track-laying machine. The track-laying machine simultaneously picks up the old ties and feeds them back to the gantry and tie cars and places the new ties at the proper spacing. It changes the old rail for new, or lifts and replaces the old rail on the new ties. Workers place tie pads under the rail before it is set on the ties. Fastener hardware is added in a separate operation.

While the highly mechanized system can only be justified in the largest jobs, equipment and methods used prior to development of the track-laying system are still practical for concrete track construction.

In review, a prestressed concrete tie is an engineered, manufactured product, that has been justified both technically and economically for installation in mainline track for a growing number of North American railroads. These installations have been accomplished by various methods, tailored to the specific requirements of the individual project. The questions "What?", "Where?", and "How?" have led to the following conclusion: prestressed concrete railroad ties have now passed the experimental stage. They are accepted by both railroads and transit authorities as a viable alternative to the long-established timber ties. As experience with concrete ties accumulates as more producers of prestressed concrete market railroad ties, and as more railroad engineers accept their use, concrete ties will be installed on longer segments of the United States and Canadian rail and transit systems for both new construction and track renewal.

Mr. Kapp: I thank Don Lewis for getting that for us from the Portland Cement Association. Our next speaker is Mr. Richard Maes, vice president of Sverdrup Corporation, who will be speaking on the design and construction of CSX's enginehouse at Rice Yard in Waycross, Georgia. Mr. Maes is a graduate of St. Norbert College in Wisconsin where he received his Bachelor of Science Degree in mathematics. Mr. Maes subsequently received his Masters Degree in construction management from Washington University in St. Louis. Mr. Maes was employed by the Ruchon Corporation for 20 years reaching the position of manager of their coal division. Mr. Maes has been with Sverdrup for the last five years as a project director and in January 1986 became their vice president and manager of the construction department as well as deputy manager of the public works and transportation department. Mr. Maes.

DESIGN/BUILD OF CSX'S ENGINE HOUSE AT RICE YARD

Richard Maes

Vice President
Sverdrup Corporation

Good morning. It is a pleasure to be with you this morning and to share with you some thoughts, facts, and opinions about the efforts involved in putting the Rice Yard Enginehouse in place and into operation.

Assisting me with the presentation this morning are two other members of the project team who were instrumental in making this project the success that it was. Mr. Gene Bohn, engineer of building for CSX, was the project manager representing the Seaboard System. Mr. John Gibbs, manager of facilities department for Sverdrup's Jacksonville office, was responsible for the design of the project. Other members of the team who contributed greatly to the project's success, but were unable to be here today, are Mr. Al Levene, assistant engineer of buildings for CSX; Mr. Chuck Downey, senior engineer, mechanical department of CSX; Mr. Aaron Long, resident engineer for CSX; Mr. Bill Sexton, manager of facilities planning for CSX (retired); and Mr. Ernie Richardson, site manager and general superintendent for Sverdrup.

Seaboard's locomotive enginehouse facility at Rice Yard is one of the nation's most sophisticated locomotive repair facilities. Located in Waycross, Georgia, this repair complex performs regularly scheduled maintenance and light repair for the 857 locomotives presently assigned to the Waycross Yard. Designed for maintenance of 750 locomotives per month, the complex can accommodate as many as 1,080 locomotives per month on a three shift, seven-day-per-week operation.

The development of the project that placed this facility into operation started in early 1983. Seaboard was planning some operational changes that included the consolidation of locomotive maintenance operations in the Southern Region of the Seaboard System. Their objective was to place into operation a modern, state-of-the-art facility that would allow the most efficient repair and maintenance operations. The master plan for the development of Rice Yard accommodated this objective. Space for a repair facility of this type was part of the Rice Yard Master Plan developed in the mid-1970's. In the spring of 1983, Seaboard publicly announced its intent to fund and place into operation in 1984 a locomotive repair facility at Rice Yard. The criteria for the project had been in the development stage for some time, but with the public announcement of the project, a new urgency was created. At this time Sverdrup became involved in the project. Working with the existing criteria, we coordinated and finalized the criteria development with Seaboard. Based on the criteria and operational schedule needs of Seaboard, the design/build, fast-track approach was selected as the best delivery method for the project. This method of delivery was selected primarily because the project met all the criteria that generally dictates the design/build approach, i.e., a tight, short time frame schedule, the need to know the total costs early in the project, and an inability on the part of the owner to completely staff the engineering or management of the project.

At this point in time, a project team was assembled and given the responsibility to "make it happen". One of the elements that helped make this project a success was the "team" approach. Team members represented the owner, designer and constructor. Acting as a team on all pieces of the project, from design reviews, to bid package reviews, to proposal reviews, to quality control reviews, things like design errors, procurement delays, and unacceptable field installations were avoided. The interaction and sharing of information developed a mutual trust and confidence that helped overcome the myriad of schedule and construction problems.

By June 1983, the design criteria and construction schedule had been finalized. The schedule showed design starting on July 1st, construction field efforts in August, and an operational start-up by December 1, 1984. Sverdrup guaranteed the project schedule and cost.

To expand on the brief description of the facility that I mentioned earlier, the addition of the locomotive enginehouse facility completed the mechanical facilities portion of Seaboard's largest and busiest computerized hump classification yard, as well as completing the "Master Plan" for expanding and modernizing Rice Yard. Along with the yard operation, the site development also considered the increasingly important environmental concerns of contaminated storm water and industrial waste water. A clean, uncluttered and efficient layout was needed to optimize the labor effort being expended to maintain and repair locomotives. A two-track "spot" maintenance system was conceived and developed by Seaboard. This system allows each locomotive to progress through the various maintenance operations on a timed cycle. An additional four tracks were designated for non-scheduled repairs of defects not correctable within the time constraints of the spot maintenance tracks. A wheel truing track, material supply track, and load test tracks were included in the layout considerations of the building complex.

Some of the key building and operational statistics of the facility may be of interest at this point. Volumes and weights of construction material were not considered to be as important as the following information:

Cost	$13.5 Million
Shop and new trackwork	16.5 Acres
Shop area:	
Wheel truing building	5,216 S.F.
Main repair building	60,000 S.F.
Dispatch shed	5,665 S.F.
Inspection and wash building	10,065 S.F.
Office, lunchroom, etc.	4,480 S.F.
Storeroom	6,800 S.F.
Shop total	92,226 S.F.
Heated area	71,280 S.F.
Locomotives (maintained and repaired) per month	750
5-ton truss-support cranes	12
5-ton top-running crane	1
30-ton cranes	1
Power service in shop	2,000 KVA
Repair building lighting level	50 foot candles
Treatment plant capable of collecting contaminated water at	500 gal/min
Automatically-controlled output	200 gal/min
Single-axle drop table serves	3 repair tracks
Automatic high-pressure underframe & truck washer on	2 inspection tracks
Lunchroom capacity	100 persons

Wheel truing machine

Storeroom served by truck or boxcar

Lubricating oils, radiator water, etc. is piped to each repair spot of shop

All locomotives are shut down before going into shop and moved in by batteries. This reduces noise level for employees.

I think it would be of interest to look in a little more detail at some of the building functions that we feel make this facility one of the "best anywhere". The two-track "spot" maintenance system is designed to move each locomotive systematically through each phase of maintenance with each spot crew being responsible for a list of maintenance items to be completed in a fixed time. The material that is needed to complete each maintenance task at each spot is stored at the necessary spot; either on the sill-height mezzanine or in the depressed floor area under the mezzanine. When that time has elapsed, the locomotive is moved to the next spot for the next phase of work. This sequence is repeated through all six spots with a locomotive completing the maintenance pass-through in an eight-hour period.

In Spot 1, test samples of water and oil are taken. Visual checks are made for leaks, levels, condition, operation and gauge readings. Overhead inspection of the upper deck and fan operation is also made.

In Spot 2, the exterior of the locomotive is thoroughly cleaned by hand while the underframe and running gear is washed by an automated, computerized truck washer. The truck washer makes separate timed soap and rinse passes along the length of the locomotive.

In Spot 3, air, fuel and oil filters are changed as well as brake shoes. Other incidental and related checks and inspections are also made.

In Spot 4, lights, motors, radios and electrical system tests are made. All air brake work is also accomplished in this spot.

In Spot 5, audible and visible alarms are checked. Brushes, commutators and leads of the generators are checked and jumper cable continuity checks are made. And, of course, before it goes back out on the road, the windshield is washed.

Spot 6 is the last spot. Here is where the final checks of fluid levels, gasket leaks, compressor settings and movement tests are made. When these checks are completed, the inspection forms are completed and the locomotive is dispatched back into service.

Any work that could not be completed in the spot system, or repair work that was discovered during the maintenance effort is completed in the non-scheduled repair area. This area is also used for the heavier repair work, such as replacement of fans and diesel engine cylinder work. The track adjacent to the depressed floor area is the jacking track. It is equipped with jacking pads and portable jacks that are capable of lifting the entire locomotive. Complete truck change-out occurs in this area. Spanning all four repair tracks is the wheel drop pit. The wheel drop table can be used to change out traction motors from three of these tracks while using the fourth as a release track. Traction motor storage is also available in this area. Traction motor delivery by rail or by truck can be accommodated.

An automatic, programmable wheel truing machine, along with a chip blower and collector, are located in the area adjacent to the repair area.

Repair and maintenance materials can be delivered either by truck or rail. Storage space is available outside, adjacent to the material supply track, or inside, in the large storeroom and on the individual mezzanines between the tracks.

Load testing is performed in an open area outside the Repair Building on two stub-end tracks. Because of the remote location of Rice Yard and the location of the test area in the yard, an enclosed area was not required to accommodate the noise abatement requirements.

The Support Building houses the offices of the supervisors, clerks and managers. Restrooms, lunchroom, vending machines, plan room, toolroom and storeroom are located in this portion of the complex.

While we have reviewed the basic building functions, some operational features are worth mentioning. The sill-height mezzanines and bascule bridges connecting them allow for easy and quick access to the locomotives and the various repair spots for either a workman or a forklift delivering parts. The depressed floor area is not a pit. It is an open area that provides well-lighted, open access to all areas of the undercarriage of the locomotive. Individual 5-ton underhung cranes are located over each maintenance or repair spot on four tracks in the Repair Building. Thirty-ton and 5-ton pushbutton or radio controlled, top running cranes are available for use at the other two tracks. Treated water, compressor oil, lube oil, journal oil and potable water are available to each spot in the Repair Building through a series of hose reel stations. Compressed air is also available at the hose reel station as well as every work area in the entire building. Six-ton capacity forklift access is available to all three operating levels of the building. In addition to the special truck washing equipment in the Wash Building, a three-zone, variable zone, exhaust hood system maximizes the control of engine exhaust during the washing cycle. An overhead inspection platform, offset from the centerline of the track, enables the Spot 1 crew to complete their inspections more quickly and safely. The wheel drop pit, located in the depressed floor area, allows access to trucks on three sides. This can be accomplished at the three active tracks. The existing industrial waste treatment system was modified to provide additional storage capacity for untreated wastes. The modified system provides continuous flow-through chemical treatment for the emulsified oily waste stream utilizing a dissolved air flotation process, with full recycle capacity. Other features, such as the 66-foot truss span minimize column interference with repair operations, as well as support the underhung crane systems, reducing additional column clutter. Liner paneling, telescoping doors, additional insulation, high bay-high pressure sodium vapor lighting and radiant heating all help to produce a facility that is well-lighted and energy efficient as well as functional, comfortable and spacious.

This presentation has traced the project from its development to the operational features that make it what it is; a sophisticated, efficient repair and maintenance facility. This was not done without some hurdles.

The project was constructed through the winter. A winter of record cold weather — seven degrees Fahrenheit in south Georgia. Slope stability in the wheel drop pit excavation, which was on the critical path, was jeopardized by the high water table and abnormal rainfall. Existing yard operations and track construction severely limited laydown areas and access to the site. Train movements delayed material deliveries daily. There was a limited local work force and the supply of skilled and unskilled labor was unreliable. A subcontractor responsible for work on the critical path had to be replaced.

Probably the biggest hurdle to overcome in both the design and construction efforts is that created by the fast-track, layered construction. The designer is required to produce individual design packages that match the construction sequence, and is thus required to pay more attention to the critical coordination of individual design disciplines. In the field, the coordination of subcontractors, all wanting to do their work without interferences, requires strong management and attention to quality and schedule concerns. These hurdles also have some benefits. You get the undivided attention of the engineer or subcontractor. There is no time to handle multiple jobs. They soon learn that the least expensive, the most error-free and the most expeditious method of executing a project is to get in, get it done and get out.

Based on the project we have just reviewed and a similar project in Kentucky, it is our opinion that design/build is a viable option for delivering large railroad projects on schedule and at a competitive price. With design/build, there is no need to sacrifice quality, design integrity or operational needs. On the contrary, design/build involves the designer in the construction effort at an early stage and reduces construction delays.

The application of the design/build approach to this project in Waycross, involving such a wide variety of complex design and construction challenges, is relatively new to the railroad industry. The locomotive enginehouse project presented Sverdrup with the opportunity to combine the complex requirements of railroad construction with the building efficiencies of the design/build approach.

Thank you for your attention and I will be happy to entertain questions in the time remaining.

Mr. Kapp: Thank you, Mr. Maes. I'll now turn the rostrum over to Mike McGinley who will introduce the next speaker.

Mr. McGinley: Last year at the Dallas Conference some of the Southern Pacific people were called away in a big hurry. Our next feature involves the replacement of a bridge. It shows Ken Wammel, division engineer at San Antonio, on the program, but he was unable to attend. We have Randy Karsten, B&B Utilities Supervisor at San Antonio, to give the presentation and then he and I will jointly answer questions afterwards. Randy.

BRIDGE REPLACEMENT AND POLLUTION CLEANUP AT SAN ANTONIO

R. C. Karsten

B&B Utilities Supervisor

and

K. L. Wammel

Division Engineer
Southern Pacific Transportation Company

This report begins as many others, with a telephone call from the train dispatcher at 11:00 p.m., on Saturday. Many of you have experienced similar calls, but not too often are we met by this.

On September 14, 1985, XRT East with 83 loads and 8,354 tons experienced a shifted load which damaged the west truss of the Medina River Bridge, causing the bridge to fail and derail 29 cars. Twenty-one cars of sulfuric acid ruptured, spilling almost their entire contents, estimated to be 300,000 gallons.

The Medina River crossing is approximately 20 miles west of San Antonio on the Southern Pacific's mainline between Houston and Los Angeles. The river is used extensively for irrigation and recreational purposes.

Normal flow of the river is 100 CF/second and is controlled by the Medina Dam, approximately 40 miles upstream. The original bridge consisted of 54 feet of IB girders, one 150 foot-truss, one 130-foot truss, and 355 feet of ODT. An additional 288-foot ODG relief bridge is 1,800 feet westward of the main crossing. The steel spans were riveted warren trusses constructed in 1902 and were rated at E 72.

After the derailment, we had 310 feet of ODT standing. The westward truss was completely destroyed and the eastward truss and IB beams were shifted eastward eight feet and two piers were severely damaged and tilted. Here is a slide showing intermediate pier damage. The pier was unreinforced concrete 31′ 6″ *x* 7′ with a 12′ *x* 37′ spread footing twelve feet below ground line. A similar pier at the west end was sheared off at the ground line.

This shows longitudinal eastward shift and damage to timber pile bent supporting the 18-foot IB spans. On Saturday night and most of Sunday our concentration was on neutralization and containment of the spill. On Sunday, at 2:55 p.m., the Car Department was given the go-ahead to clear the wreck. The first car was cleared at 3:10 p.m. and by 4:45 p.m. a total of nine cars had been cleared. This gave access to additional pools of acid so that the vacuum trucks could be brought in to work through the night. During this time, the Bridge Department had time to formulate construction plans, locate available pile drivers and material and assemble bridge and building and other forces.

A detour route was established. The reconstruction plan developed was to build a new 330-foot bridge using our standard 30-foot prestressed concrete on H pile bents consisting of our 14 inch 73 pound piles per bent braced horizontally and diagonally with 4 x 4 x 1/2-inch angles.

Because of the length and height of the new structure, longitudinal braces between BTS 6 and 7 and at the west end would have to be installed before speed could be increased above 30 miles per hour.

Exposed pilings would be painted with Corbomastic No. 14 epoxy. The eastern 50 feet of the bridge would be filled. Temporary post and stringer repairs would be made to the east end of the remaining ODT.

The west pier was sheared off at the ground line and fell in line with BT 11. The new bridge bents could not be shifted longitudinally without interfering with the other concrete piers. Therefore, an explosive contractor was called in to remove the base. Fifty-three holes, two to six feet deep were drilled using various spacing and angles. Forty sticks of 1-1/4 inch x 8 inch 80 percent gelmite and 50 pounds of ammonium nitrate fuel oil were used. A four-foot earthen cover was placed over the concrete before the simultaneous detonation. No delay caps were used in order to maximize the breakage.

The 150-foot truss was rolled in the clear by the use of dozers and winches. It would be necessary to fill 80 percent of the channel and construct a working pad for a crawler crane with hammer and leads.

A motor crane with swinging leads would start at the west end at BT 10 and work east and west. An 80-ton locomotive crane on each end would set caps, girders and lay track panels. Work shifts, supervisors, material and equipment were scheduled.

Mechanical problems with the crawler crane prompted ordering another motor crane and using the eastward locomotive crane to drive the abutment bent.

The first pile was completed at 11:30 p.m. on September 16th. A total of 3420 LF of piling was driven. The last pile was completed at 4:00 p.m. on Wednesday, September 18th. For one brief moment, we had four hammers working.

Here we have the 150-foot truss rolled into the clear and the engineering party starting to lay out the bridge. It was a very interesting layout problem since both pile drivers were started at intermediate points.

These are the two 150-ton motor cranes with swinging leads and No. 22 Del Mag Diesel hammer with 40,500 foot per pound energy rating. The Southern Pacific maintenance of way locomotive crane had a link belt 520 with 29,000 feet per pound crawler crane with a hammer.

The original estimate was to drive a bent a shift with each rig or four bents per day. Each bent required 18 hours of lining, cutting and approximately 50 LF of welding. Almost all of the piles needed to be spliced which added another hour to the one and one-half hours per pile.

We called in all of our division's certified welders not only from the B&B Department, but from Water Service, Track and A&WE. An additional 12 welders were hired on a contract basis. This gave us two 12-hour shifts of ten welders each. We used 600 pounds of 7018 rod.

By the end of the third day, the company welders had become exhausted and we relied heavily on the contracted welders, many working 36 hours straight with brief rest periods.

Caps, girders and track continued to follow and by Thursday morning we had all girders set except spans 3, 4 and 5. At 12:01 p.m. on Thursday, the last girder was set and the first train crossed at 1:30 p.m.

Pollution Cleanup

The dispatcher initially reported that the train was carrying 26 car loads of sulfuric acid. Some cars were reported to be in the river and there was a possibility of a fire. It was confirmed later by trains consist, waybills and on-site inspection that 21 of the 26 cars were involved and had ruptured. The spill was estimated at 300,000 gallons and later calculated at 286,381 gallons.

The "Emergency Handling of Hazardous Material in Surface Transportation" book issued by the Bureau of Explosives lists sulfuric acid in its neat form of 98.6 percent pure as corrosive material, acidic, poisonous.

If Material Involved in Fire — extinguish fire using an agent suitable for type of surrounding. (Material itself does not burn or burns with difficulty). Use water in flooding quantities as fog. Cool all affected containers with flooding quantities of water. Apply water from as far a distance as possible.

If Material Not Involved in Fire — Keep material out of water source and sewers. Build dikes to contain flow as necessary. Neutralize spilled material with crushed limestone, soda ash, or lime.

Personal Protection

Avoid breathing vapors. Keep upwind. Avoid bodily contact with the material. Wear rubber boots, protective rubber gloves, and safety glasses. Do not handle broken packages without protective equipment. Wash away any material which may have contacted the body with copious amounts of water or soap and water. If contact with the material is anticipated, wear full protective clothing.

Precautionary Measures

All water usage downstream of the derailment was ordered stopped by Hazardous Material Control Supervisor, who was the On Scene Coordinator of the environmental emergency portion of this project. The police and fire department personnel were advised to evacuate a one-mile radius downwind and downstream of the site. A temporary evacuation center was set up at a truck stop and later moved to the local high school. Local, county, state and Southern Pacific police cordoned off the entire area to keep the curious from injuring themselves or others and a command post was officially set up at the west end of the site.

Environmental Measures

Course of action

Due to our training and experience as a transportation industry, in situations such as this we know what course of action to take. If adequate containment and recovery operations are taken, the principal thrust of the authorities will be to observe, monitor the progress and provide advice and council.

Immediate efforts must be made to safeguard life and property, including determining the source, stopping the flow and preventing material already spilled from reaching a waterway or preventing any additional material from entering a waterway.

Notification to the following authorities was made:

Environmental Protection Agency
National Transportation Safety Board
Federal Railroad Commission
Railroad Commission of Texas
Texas Department of Public Safety
Texas Department of Health
Texas Department of Water Resources
Texas Parks and Wildlife Department
Red Cross
San Antonio River Authority
Bexar County Sheriff's Department
Bexar County Fire Marshal
San Antonio Emergency Medical Services
Five local fire departments
Numerous volunteer fire departments

Inspection of the site revealed that some of the sulfuric acid had pooled under the remaining portion of the bridge and surrounding area. About 150,000 gallons had flowed into a gravel pit 100 yards south of the site and approximately 50,000 gallons went down a gravel road and into the river. The river flow was measured at 65 cubic feet per second.

Two hours and ten minutes after the accident, company equipment and material were arriving and additional machinery for containment, clearing and neutralization was ordered.

Shortly thereafter, a D-8 bulldozer was being used to build dikes on the road parallel to the river. Four 25-ton lime blower trucks were stationed at strategic locations. The weather and wind direction were monitored closely.

The decision was made not to attempt a river diversion as the flood plain passed through the high school properties. The company electrical department positioned emergency light plants around the site. Containment trenches, berms, and dams had stopped the acid flow by 4:30 a.m. At 6:20 a.m., September 15th, vacuum trucks began loading the sulfuric acid contained in the trenches and pools.

A normal PH reading is 7. The readings that we were getting were considerably less. Therefore, at daylight the lime blower trucks began discharging into the river upstream and downstream from the bridge and into containment trenches. The PH reading at the bridge was 3. two loads of lime were put into the gravel pit to note the reaction as the PH there was 1. The chemical reaction to the lime was violent. We knew that it would take a large amount of lime to neutralize the gravel pit so we concentrated on the operation of the river. At the same time we were tracking a sulfuric acid plume as it moved down the river. An intercept point had been established and consisted of six lime blower trucks.

A containment boom was installed above the low water crossing to prevent contaminated debris and contents of the boxcars from going any further downstream. At 5:00 p.m., due to high winds and possible thundershowers, an evacuation of the derailment area was ordered. On the morning of September 16th the evacuation zone was lifted, but the area schools did not return to their regular schedules until the next day.

At 5:30 p.m. all fire departments were

notified that their services were no longer required. Clearing, rebuilding, and lime application to the soil and waterway continued. An emergency wash area was set up and manned by Emergency Medical Services and a trained company employee.

On September 19th at 7:00 a.m. we began a neutralization operation at the gravel pit which consisted of a lime and magnesium hydroxide slurry mixing tank and a concrete pumping boom truck. The plan was to inject the lime slurry at numerous locations around the gravel pit. We used two four-inch pumps that drew suction from the pit and discharged to areas which were inaccessible to the truck. An air compressor with a one-inch hose and a one and one-half-inch black iron pipe as a lance was used to mix lime that had accumulated on the bottom of the pit. Continuous PH testing was mandatory for effective control of all the operation.

Monitoring wells were drilled around the gravel pit and river bank to see if any of the sulfuric acid was moving through the ground water table. Foam that had accumulated upstream from the containment boom at the low water crossing was dispersed with a fog nozzle. The gravel road was neutralized by blading the surface back and forth while applying water and mixing with lime. The bladed material was disposed of at an approved Class II nonhazardous material disposal site.

On September 21, the PH on the river had stabilized at 8.1 at six locations. On September 22nd at 3:00 p.m. the environmental contractor began moving equipment, material, and supplies onto the site. They had been working with Southern Pacific's environmental engineer developing a long-range cleanup plan. It is important for the company representative to personally handle interchange of information, ideas and plans with the authorities and to approve views and recommendations by the contractor. The long range plan was to neutralize the acid contaminated soil under and adjacent to the bridge by an earth injection system and to pump the water from the gravel pit through a centrifuge to remove solids and lime residue and then return the water back into the gravel pit. Approximately 1,000 tons of hydrated lime were used. Thirteen vacuum truck loads or 52,000 gallons of sulfuric acid were removed and disposed of at an injection well at Texas City, Texas. The recovery and monitoring operations continued until the end of December, 1985.

Safety

Safety as you all know is the first thing to be considered when doing anything, whether it is at home or on the job. I had a lot of difficulty placing this section towards the end of my report, but I felt it would be more effective after you knew the circumstances involved.

These are some things to consider:

1. The volunteer fire departments that participated at this disaster are too numerous to mention here but must be considered indispensable during an operation like this.
    a. They set up and manned the decontamination wash-down station by 2:30 a.m. on the night of the incident. They used PH buffer solutions and copious amounts of water to wash down numerous railroad and contractor employees.
    b. They worked as crowd control.
    c. They provided first aid for the usual cuts and contusions that occurred.
    d. They did everything they could to help no matter what was requested, even to the point of allowing us to borrow fittings, hoses and nozzles.
2. All personnel were required to wear eye protection and cartridge respirators. However, for preliminary assessment of the situation, full-face eye and breathing protection was recommended. At midnight on a Saturday these are almost impossible to find, as you can well imagine. Rubber boots, rubber gloves and protective clothing must be used.
3. It was necessary to increase the air space restriction from 500 feet to 3,000 feet due to the prop wash that was created from one of the news station helicopters.
4. Emergency Medical Service personnel and an ambulance were at the scene until the wreck clearing and other hazardous operations were completed and the site was declared safe to work in.
5. One of the company employees who is a CPR and First Aid Instructor was on the site. The men felt more comfortable talking with him as compared with an emergency medical technician.

Closing

Even though the ground surface under the bridge, the gravel pit and the river had been subjected to the catastrophic effects of the sulfuric acid, Mother Nature, aided by man, has been able to restore the area to a level that is as good as it was before. It was estimated that 100,000 fish were killed and 75,000 were replanted in the area. The area has continued to be monitored resulting in good reports.

Mr. McGinley: Thank you, Randy. I would like to turn the podium back to President Bessey.

President Bessey: Thank you very much. Many times we see special features start off with a catastrophe and I think this one ranks pretty high on the list. But the positive part is viewing how these problems caused by the catastrophe were solved. I think this was an excellent presentation and I thank you very much.

At this time I would like to call on John Horney, chairman of the Resolutions Committee

REPORT OF RESOLUTIONS COMMITTEE

Having reached the closing of the Annual Joint Conference of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America, and being deeply indebted to all those members and friends who have contributed their time and effort to make this Conference a success, it is right that we should acknowledge this indebtedness and that it shall be so entered into the minutes of this meeting.

Be it further resolved that our deep appreciation be extended to those who have honored our two Associations with their presence by their informative addresses:

Marshall Suloway, Senior Vice President, Envirodyne Engineers;
E. B. Burwell, President, Southern Railway;
J. T. Gorley, Union Pacific Railroad;
Roy T. Smith, Chicago Transit Authority;
J. T. Hunter, Federal Railroad Administration;
S. A. LaRocca, Long Island Rail Road;
J. C. Fouilland, Desquenne and Giral;
David L. Smoot, Indiana Hi-Rail;
Perly A. Schoville, Union Pacific Railroad;
George E. Krupa, Delon, Hampton and Associates;
David Holt, David L. Holt Company, Inc;
R. J. Maes, Sverdrup Corporation;
Randy C. Karsten, Southern Pacific Transportation Company;
Ken Wammel, Southern Pacific Transportation Company;
W. R. Moore, American Plywood Association;
D. C. Bender, National Concrete Masonry Association;
William Kiley, Washington Metropolitan Area Transit Authority

and to all the committee chairmen who, with the loyal cooperation of the committee members, prepared the interesting and instructive reports that have been presented.

Be it further resolved that a very special thanks is expressed to Ron McDaniel, President of REMSA, and to all members of the Railway Engineering Maintenance Suppliers Association for the fine reception that we enjoyed on Tuesday evening. Our thanks are also expressed to Mrs. Marge Bessey and Mrs. Bonnie Moorman and their committee for their efforts in arranging registration and entertainment for our wives. Our thanks also to the management and staff of the Palmer House and Towers. We also thank the Chicago and North Western and the Santa Fe railroads who lent assistance to our registration desk during the conference. A special thanks goes to Pat Weissmann and Barbara Marlow. Without their unselfish assistance, these two Associations would have great difficulty functioning. That's an understatement, I believe.

And be it finally resolved that both Associations express their heartfelt thanks to the outgoing presidents, Don Bessey and Wick Moorman, who have spent so much time and effort in guiding the activities of our two Associations with great efficiency and dedication during the past year.

I move these resolutions be adopted.

Respectfully submitted,

John J. Horney, Chairman
Resolutions Committee

President Bessey: Thank you, John. I would like our immediate past presidents, Mr. Jim Williams of the American Railway Bridge and Building Association and Mr. Dave Staplin of the Roadmasters and Maintenance of Way Association of America, to come forward and install the officers-elect for the coming year. Mr. Williams. Mr. Staplin.

INSTALLATION OF OFFICERS

Mr. Williams: The following is a list of officers-elect of the American Railway Bridge and Building Association for the administrative year 1986-1987. The officers so named, except the first one, please step forward and take a position in front of the podium.

For Treasurer, James M. Williams, Supervisor B&B (retired), Elgin, Joliet and Eastern Railway.

For a one year directorship, John J. Horney, General Structures Construction Engineer, Union Pacific Railroad, Omaha, Nebraska.

For directors for a three year period: H. L. Davidson, General B&B Supervisor, CSX Transportation, Nashville, Tennessee; John A. Van Huis, Bridge Engineer, Chicago and North Western Transportation Company, Chicago, Illinois; and Carl E. Thompson, B&B Master, CP Rail, Burnaby, British Columbia, Canada.

For Junior Vice President, Byron T. Burns, Steel Bridge Inspector, Atchison, Topeka and Santa Fe, Topeka, Kansas.

For Junior Vice President, Ray A. Tallent, Process Engineer-Structures, Norfolk Southern Corporation, Atlanta, Georgia.

For Senior Vice President, Donald J. Lewis, Senior Structural Designer, Illinois Central Gulf, Chicago, Illinois.

For President, John T. Kapp, Project Manager-Construction, Conrail, Philadelphia. Dave.

Mr. Staplin: The following is a list of officers-elect of the Roadmasters and Maintenance of Way Association for the administrative year 1986-1987. The officers so named please step forward:

For directors: McKinley Scott, Director of Track Maintenance Northeast Corridor Region, Amtrak, Philadelphia. E. E. Schubel, Manager of Rail, Burlington Northern, Inc., Naperville, Illinois. R. W. Wright, Division Engineer, Norfolk Southern Corporation, Bellevue, Ohio. Mr. Wright has an illness in the family and will not be able to attend today.

For Treasurer, Lester H. Kelley, District Engineer, CSX Transportation, Jacksonville, Florida.

For Second Vice President, E. J. Matte, Supervisor of Maintenance, CP Rail, Toronto, Ontario, Canada.

For First Vice President, Ray E. Snyder, Assistant Chief Engineer-Maintenance, Chicago and North Western Transportation Company, Chicago, Illinois.

For President, Michael J. Marlow, Supervising Engineer Tracks and Property, Elgin, Joliet and Eastern Railway Company, Joliet, Illinois.

Election to a position of leadership in any organization is an honor not to be taken lightly. Your fellow members, in electing each of you to your respective office, have expressed confidence in you. First, that you are to discharge your several duties with distinction. Second, that you are willing to do so.

Mr. Williams: As the officers of our associations, you will represent to the citizens of this country the true meaning of railway bridge and building, roadway maintenance and construction. You will be our collective voice in the industry. Thus you will be our common bond with railway personnel throughout the United States and the world.

Mr. Staplin: As the officers of our associations you will represent our best interests. In any of your activities or projects always remind yourselves that your attitude must be a part in any undertaking sanctioned by your respective Associations. In this you will be adhering strictly to the Constitution and By-laws of our associations.

As a representative of the Roadmasters and Maintenance of Way Association, I install each of you in the office to which you were elected in your association.

Mr. Williams: As a representative of the American Railway Bridge and Building Association I install each of you in the office to which you were elected in your association. Please remain standing so that Mr. Staplin and I may come down and congratulate you and the audience may applaud.

President Bessey: At this time I would like to call on Mr. Ron McDaniel, President of REMSA. Mr. McDaniel.

Mr. McDaniel: Thank you, Don. It is a distinct pleasure for me as President of REMSA to congratulate your associations on their selection of new officers and members of your board for the coming year. I would certainly be remiss if I did not thank Don Bessey and Wick Moorman and all the members of the boards, plus Pat Weissmann and Barbara Marlow, for the excellent cooperation they have given REMSA during the past year. We feel certain this state of cooperation will continue and look forward to working closely together. As most of you know it has been customary for REMSA to present the in-coming presidents with a symbolic gavel of their authority for the office during the upcoming term. So barring a mix-up of these gavels, I would like to present to Mr. Kapp, president-elect of the American Railway Bridge and Building Association this gavel and I trust you will use it in its symbolic manner for the coming year.

President-elect Kapp: Thank you very much, Ron.

Mr. McDaniel: Again, on behalf of REMSA I would like to present this gavel to the Roadmasters and Maintenance of Way Association of America president-elect Mr. Marlow. Again, I hope you only use this in its symbolic manner in the coming year.

President-elect Marlow: Thank you very much, Ron.

Mr. McDaniel: And now, an additional function. I think in years past it has been done in opening session, but it was changed this year. REMSA has given out pin awards to the two gentlemen who have guided your associations during the past year. So what I would like to do now is to present to Mr. Moorman, on behalf of the membership and as president of the Roadmasters and Maintenance of Way Association for 1985-1986, this pin. Thank you.

President Moorman: Thank you, Ron.

Mr. McDaniel: And to Don Bessey, this is a matching pin to the President of the American Railway Bridge and Building Association for 1985-1986. Don.

President Bessey: Thank you very much.

Mr. McDaniel: Thank you again for this opportunity.

President Bessey: The annual joint conferences of the American Railway Bridge and Building Association and the Roadmasters and Maintenance of Way Association of America is drawing to a close and it is time to check the score sheet. On Monday, we talked about getting involved. Did you take part in discussions from the floor? Yes. Some. Did you attend all the sessions? By and large the attendance was good, even at this closing session, as I can remember times where there were more people here at the head table than sitting in the audience during the closing session. So you did get involved. Now take one more step. Fill out the special subject cards and take an active part in next year's conference. If you changed out a bridge under traffic in record-breaking time and you are proud of your accomplishments, share this accomplishment with all of us. Fill out the card. Trenching, solving bridge problems, or did you build a building? Were you involved in remodeling a building? Share your accomplishments with us. Fill out the card. Be a contributor to next year's conference. Become involved. Fill out the card and hand it in at the door or mail it to headquarters as soon as possible because planning for next year gets underway soon.

Get involved. Be a contributor to your association. Become a John Kapp, he put this document together. He prepared the conference program. Or be a Don Lewis and search the country, or should I say, search the world for special features. Be a Ray Tallent and sheperd the special subject teams, working with Mark Walbrun, Don Steele and Ed Bond. Be a John Smith who took over the registration duties at the last minute; a Jim Williams as treasurer and nominating committee chairman. Be a John Horney who takes on one more year on the board; a Bill Semioli with his contributions on membership and advertising; a Byron Burns, chairman of ladies activities, with a great job well done. And all the past presidents and past board members, still involved — that is what makes an association like ours live and grow. On behalf of both Associations, I would like to express our appreciation to REMSA and to the suppliers for their help and hospitality during this conference. I hope all of you sold your products over the last two and one half days at 100 percent over your quota.

I extend my gratitude to Pat Weissmann, as always a great job; to Barbara Marlow; and of course, a special thanks to Frances Dachs who year after year helps with the ladies activities. And last but not least I would like to thank my wife, Marge. She and all the ladies are a big part of the B&B and Roadmasters Associations.

So, before this starts sounding like an academy award acceptance I will close by saying thank you for the honor of serving as president of your association for the past year. And now President-Elect John Kapp, I turn the rostrum over to you.

President-elect Kapp: Thank you, Don. As many of you know, I was absent from the first two days of the conference due to an emergency on my road. I understand that in my absence Don Bessey, at first was "sweating bullets" trying to figure out how he could install the new president inabsentia, but I understand from unreliable sources that Don's depression quickly swung to joy as he contemplated changing the B&B's constitution so he could be elected to successive terms. I don't know what the final outcome of Don's efforts might have been, but I am glad I made it back in time so I didn't have to find out.

I must admit that when I agreed to chair a committee report in the spring of 1980 I never dreamed that I would be standing here today accepting the presidency of the Association. It is indeed an honor for me.

I would hope that in the upcoming years many of you would volunteer to serve as committee members as I did back in 1980. It **can** be the beginning of an educational and enjoyable experience such as it has been for me. You need not be an expert to become part of a committee by contributing your experience on a subject. Without the contributions of different roads, presentations on subjects become slanted and do not convey the true way that work is accomplished by our industry. And that is what our associations are all about: the sharing of experiences that promote discussions amongst our roads that will allow the actual, physical work out on the property to be accomplished in a better and safer way so that our railroads will not only survive, but excel.

Extend yourselves, share your knowledge, the experience will be good for you and good for your road.

Now on behalf of the association and myself I want to thank Don Bessey for his years of service to the B&B Association. I enjoyed the fine presentations that Don has made as well as the interesting speakers he has introduced over the past eight years.

In recognition of his service, I would like to give Don this plaque which reads "Presented to D. A. Bessey for his services as President 1985-1986 and Vice President 1982-1985." Don.

President Bessey: Thank you, John.

President-elect Kapp: I know Don will be a contributing member of our association for years to come.

I also want to congratulate our new senior vice president, Don Lewis, for the excellent speakers he engaged for our conference. I acknowledge vice president Tallent for his efforts in the preparation of all of our committee reports and I congratulate Byron Burns on his election to junior vice president.

When I accepted the nomination to become junior vice president in 1983, I didn't know that by the time I became president, six of the previous seven presidents before me would be retired from their roads. I sure hope that I am the first of a new line of presidents that will still be gainfully employed by a railroad long after I leave office.

To members of REMSA, I again say Thank you. Without your support this conference would not be possible.

I look forward to working with Pat Weissmann and Barbara Marlow in the upcoming year. Pat is the glue that bonds our associations together. The excellent work of our home office personnel keeps the machinery in motion that makes these conferences a success.

Thank you. Wick.

President Moorman: I just have a couple of brief remarks. I would like to take just a minute to thank everyone. I have had a very good year as President of the Roadmasters Association. I told some people at dinner the other night that my becoming president was really an illustration of "even a blind pig picks up a few acorns". I have been extremely lucky because I have had a lot of good people and I'm a really good administrator at times and that is really the highlight. I would like to take a minute just one more time to thank all the officers and board members of our association for all their assistance during the past year. My job has been so very easy this year although I think Pat thinks the reason my job was easy was because I didn't do a lot of things I should have. I do want to thank REMSA and Ron McDaniel for all of the support they give to our organizations. And I would like to thank Pat and Barbara. We talk about them all the time. John said Pat was the glue that holds us together and I always think of her as Reggie Jackson said he was "the straw that stirs the drink". At this time I would like to present a pin to president-elect Marlow. Mr. Marlow. The Association is fortunate to have Mike. He will keep you on a straight line, of course, because Barbara is in the office.

President-elect Marlow: Thank you, Wick. It is a distinct honor for me to be able to move up the office of President in this great organization. I am happy for this opportunity and look forward to the challenges of this next year, one of which will be to do as fine a job as the others before me have done. At this time I would like to present to Mr. C. W. "Wick" Moorman, this handsome plaque in appreciation for his fine job as president. Which reads, "Appreciation Award, presented by the Roadmasters and Maintenance of Way Association of America to C. W. Moorman for his services as president 1985-1986."

President Moorman: Thank you, Mike, and thank you all.

President Marlow: As I stated earlier I am looking forward to meeting the challenges facing the Roadmasters Association. The biggest challenge as I see it is keeping our organization viable, strong and active. This cannot be done without the help of the entire membership. The officers and directors cannot do this alone. In the six years I have been on the board I have worked with many fine people, including those who will serve with me during this next year I look forward to working with them and I am confident that together we can continue to make the Roadmasters Association the fine organization that it has been.

During the past couple of days you have heard the statement "get involved". This is a theme that I will repeat throughout this next year. In our organization our objective is to raise the standards and improve the methods of track and roadway maintenance on American railways. We are an organization committed to exchanging ideas with each other. The Roadmasters is fortunate that the officers and directors have the support of their respective railroads who permit them the time to take an active role. However, we would like to see participation from those roads not represented. We need the support of all the roads and their respective chief engineers, plus the transit systems and short lines as well as the Class I railroads. Maintenance of way employees should be encouraged and permitted to be actively involved in the roadmasters organization. I realize in these difficult times it is hard to justify to upper management the expense of allowing people to participate. It is also during these difficult times that you need new ideas more than ever. We need your help. Chief engineers, please encourage your people to get involved. This organization cannot survive if there are only a few interested in participating.

In closing I would like to thank REMSA for their continued support and hospitality and I look forward to working with its officers and directors this next year. We hope we will be able to see most of you or all of you at the 1987 conference in Kansas City, Missouri.

Members and guests, if there are no other matters to be brought before this session, I will declare this 91st annual conference of the American Railway Bridge and Building Association and the 98th annual conference of the Roadmasters and Maintenance of Way Association of America adjourned.

(Left to right) Director C. E. Thompson, CP; Junior Vice President B. T. Burns, AT&SF; President J. T. Kapp, Conrail; Junior Vice President R. E. Tallent, NS; Senior Vice President D. J. Lewis, ICG; Director J. A. VanHuis, C&NW; Director J. J. Horney, UP.

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Tanner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Eggleston
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnson	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. I. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. F. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. F. King	I. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	. . . .	. . . .	F. O. Whiteman	A. G. Shaver
Treasurer	. . . .	. . . .	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver† Lorene Kindred‡ Elinor V. Heffern	Elinor V. Heffern	Elise LaChance	Elise LaChance
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1942 ‡ To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954–1955	1955–1956	1956–1957	1957–1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. VonSprecken
	H. D. Curie	E. R. Schlaf	T. M. VonSprecken	W. H. Bunge
	J. M. Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958–1959	1959–1960	1960–1961	1961–1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962–1963	1963–1964	1964–1965	1965–1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966–1967	1967–1968	1968–1969	1969–1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fuller	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970–1971	1971–1972	1972–1973	1973–1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinski	W. S. Stokely	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokely	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. F. Brakensiek

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewski	W. E. Halley
	W. R. Hyma	R. C. McMaster	W. J. Gunkle	K. L. Wammell
	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammel	B. J. King
	R. C. McMaster	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammel		W. S. Stokely

	1978-1979	1979-1980	1980-1981	1981-1982
President	W. C. Sturm	D. C. Gould	J. W. Chambers	W. R. Hyma
Sr. V.-Pres.	D. C. Gould	J. W. Chambers	R. C. McMaster	O. C. Denz
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster	W. R. Hyma	J. Budzileni
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma	O. C. Denz	J. M. Williams
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Pat Weissmann
Treasurer	W. F. Armstrong	W. F. Armstrong	W. F. Armstrong	W. C. Sturm
Directors	J. Budzileni	O. C. Denz	J. W. Davidson	D. A. Bessey
	B. J. King	W. J. Gunkle	C. M. Russell	J. N. Michel
	J. G. Robertson	W. S. Stokely	J. M. Williams	P. H. Saletnik
	O. C. Denz	L. D. Green	D. A. Bessey	O. D. Anthony
	E. C. Patterson	C. M. Russell	J. N. Michel	J. T. Kapp
	W. S. Stokely	J. M. Williams	P. H. Saletnik	D. J. Lewis
	L. D. Green	D. A. Bessey	O. D. Anthony	J. W. Davidson
	C. M. Russell	J. N. Michel	J. T. Kapp	H. J. Laga
	J. M. Williams	P. H. Saletnik	D. J. Lewis	A. S. Uppal

	1982-1983	1983-1984	1984-1985	1985-1986
President	O. C. Denz	J. Budzileni	J.M. Williams	D. A. Bessey
Sr. Vice President	J. Budzileni	J.M. Williams	D.A. Bessey	J. T. Kapp
Jr. Vice President	J. M. Williams	D.A. Bessey	J.T. Kapp	D. J. Lewis
Jr. Vice President	D. A. Bessey	J.T. Kapp	D.J. Lewis	R. A. Tallent
Secretary	P. A. Weissmann	P.A. Weissmann	P.A. Weissmann	P. A. Weissmann
Treasurer	P. H. Saletnik	P.H. Saletnik	P.H. Saletnik	P. H. Saletnik
Directors	O. D. Anthony	J.W. Davidson	T.E. Kuhn	B. T. Burns
	J. T. Kapp	D.J. Lewis	D.R. Ladner	J. J. Horney
	D. J. Lewis	T.E. Kuhn	R.A. Tallent	W. J. Semioli
	J. W. Davidson	D.R. Ladner	B.T. Burns	R. E. Fronczak
	H. J. Laga	R.A. Tallent	J.J. Horney	W. P. Cunningham
	A. S. Uppal	B.T. Burns	W.J. Semioli	J. H. Smith
	T. E. Kuhn	J.J. Horney	D.W. Brookings	E. Bond
	D. R. Ladner	W.J. Semioli	W.P. Cunningham	D. L. Steele
	R. A. Tallent		J.H. Smith	M. C. Walbrun

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither endorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1.* The membership of this association shall be divided into four classes, viz: Members, life members, associate members and honorary members.

Section 2.* A member shall be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway bridges, buildings and water service facilities: or in the employ of a public regulatory body, a professor of engineering or architecture, a technical editor, a government or private timber expert, a consulting engineer, or an engineer in his employ, engaged in the engineering, construction and maintenance of railroad-related facilities or an engineer employed by a technical service or research and development organization, an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this association. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

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*Amended September, 1976.

**Amended September 20, 1948

††Amended March 10, 1958.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8.** Only members shall hold office in this association, and only members and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1‡‡. The officers of the Association shall be a President, two Junior Vice Presidents, a Senior Vice President, a Treasurer and nine Directors, who, with the most recent Past President, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND SECRETARY AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

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*Amended October 16, 1941.

†Amended September 21, 1957.

‡Amended September 28, 1966.

‡‡Amended September 20, 1978.

°Amended October 7, 1982.

Section 2††. The President, two Junior Vice Presidents, and Treasurer shall hold office for one year and the Directors for three years; three Directors being elected each year. The Senior Vice President shall hold office for one year and ascend to the office of President at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A Director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.° The term of office of the treasurer may be terminated at any time by two-thirds vote of Executive Committee. The compensation of the treasurer shall be fixed by a majority vote of the Executive Committee.

Section 4.° The secretary shall be appointed by a majority vote of the Executive Committee and the term shall terminate with the appointment of successor. The Executive Committee shall have the power, by two-thirds vote, to remove the secretary and appoint successor at any time. The salary of the secretary shall be decided by a majority vote of the Executive Committee.

Section 5.° The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive Committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1†. Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears, may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applications) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

***DUES

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:[°]

Members, $20.00; Associate Members, $20.00.[§]

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7.‡‡ The Vice-Presidents in order of seniority shall preside at meetings in the absence of the President and discharge his duties in case of a vacancy in his office. The Senior Vice President shall have the senior position of Vice Presidents.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.# After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations provided that such nominations are received by the President in writing not less than thirty (30) days in advance of the first day of the annual meeting. Such nominations should be addressed to the President of the Association at its headquarters office.

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‡Adopted October 17, 1940.

#Amended March 23, 1983.

†Amended September 20, 1948.

‡Amended September 21, 1957.

‡‡Amended September 20, 1978.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDERS OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

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†Amended September 20, 1948.
*Article adopted 1922.
**Amended September 20, 1948.
‡Amended September 21, 1957.
***Amended September 15, 1965.
§Amended June 8, 1984

ACTIVE MEMBERS

	Joined
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Anderson B R, Supervisor, Conrail, 2100 Stella Ct, Rm 310, Columbus,OH 43215	10-04-82
Anderson T C, Dsgn & Const Mgr, Schnabel Foundation Co, 210 Cleveland St, Cary,IL 60013	08-10-83
Anderzunas P P, Asst Div Engr, Conrail, 211 Knotty Oak Dr, Mt Laurel,NJ 08060	05-08-84
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Baker R C, Supv B&B, EJ&E RY, PO Box 880, Joliet,IL 60434	09-14-80
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Bartholomew D E, Sr Proj Mgr RR Facilities, Sverdrup Corp, 1200—112th Ave NE POB 369, Bellevue,WA 98009	09-15-86
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Beattie G W, Asst Div Engr, AT&SF RY, PO Box 1763, Pearland,TX 77588	11-05-82
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Beirne J M, Asst Div Engr, N&W RY, Union Stn, Moberly,MO 65270	08-20-76
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Billingsley R E, Gen B&B Supv, NS Corp, 8 N Jefferson St, Roanoke,VA 24042-0049	12-05-86
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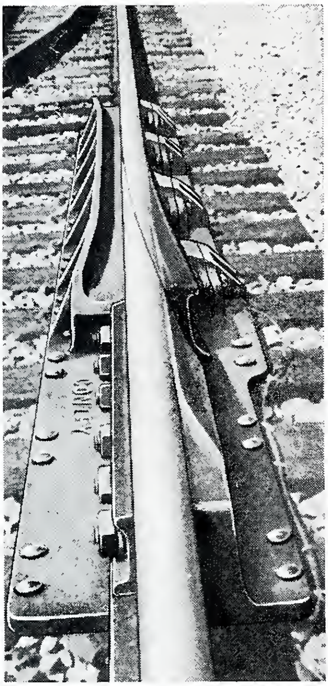

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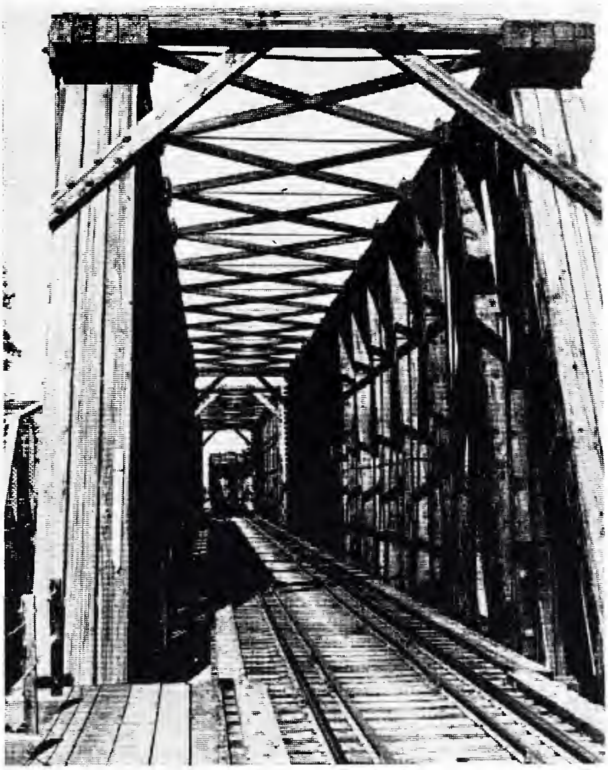

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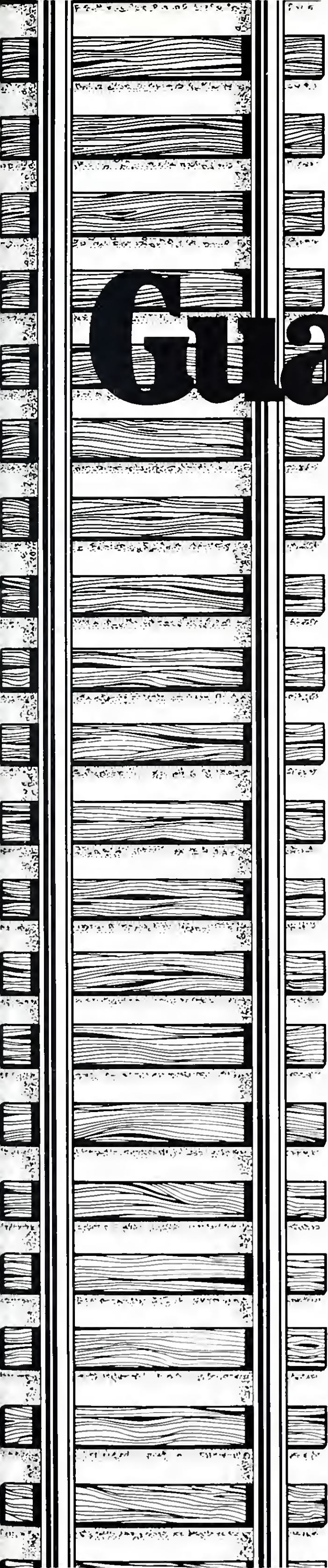

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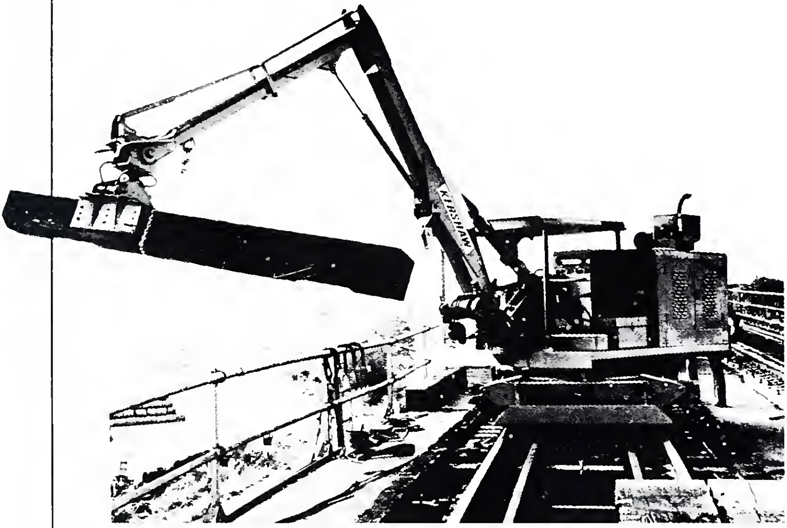

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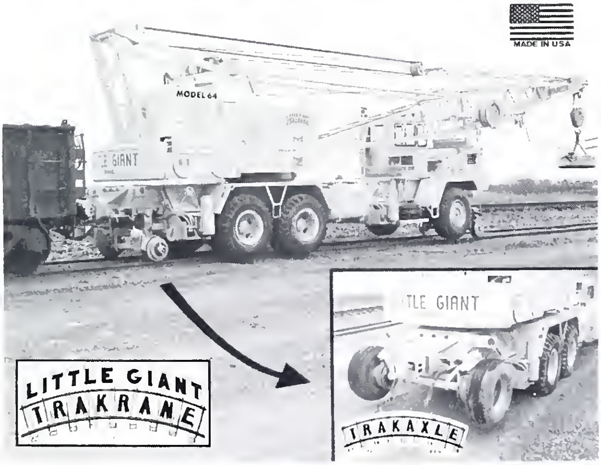

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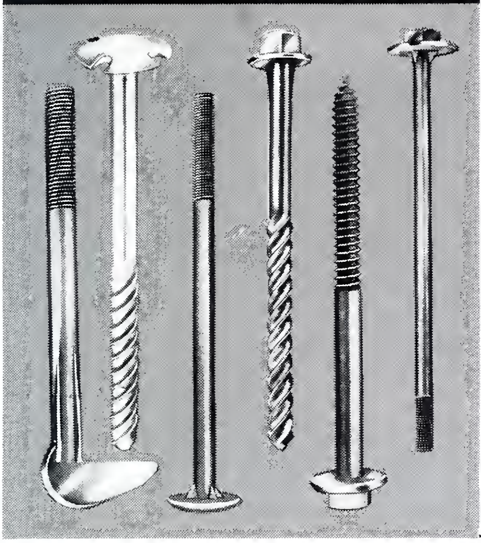

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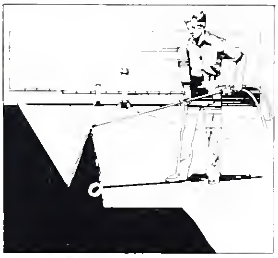

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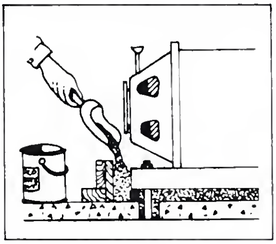

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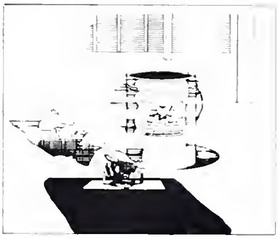

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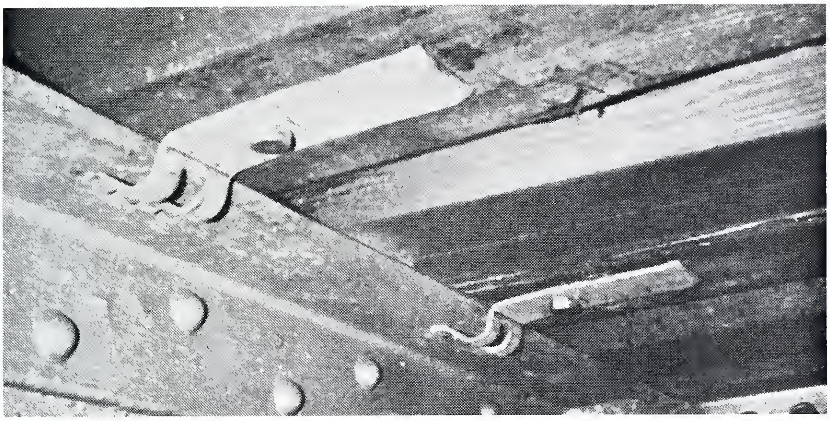

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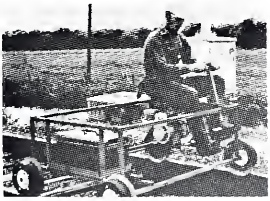

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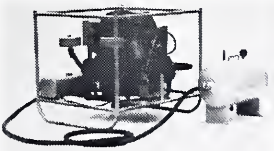

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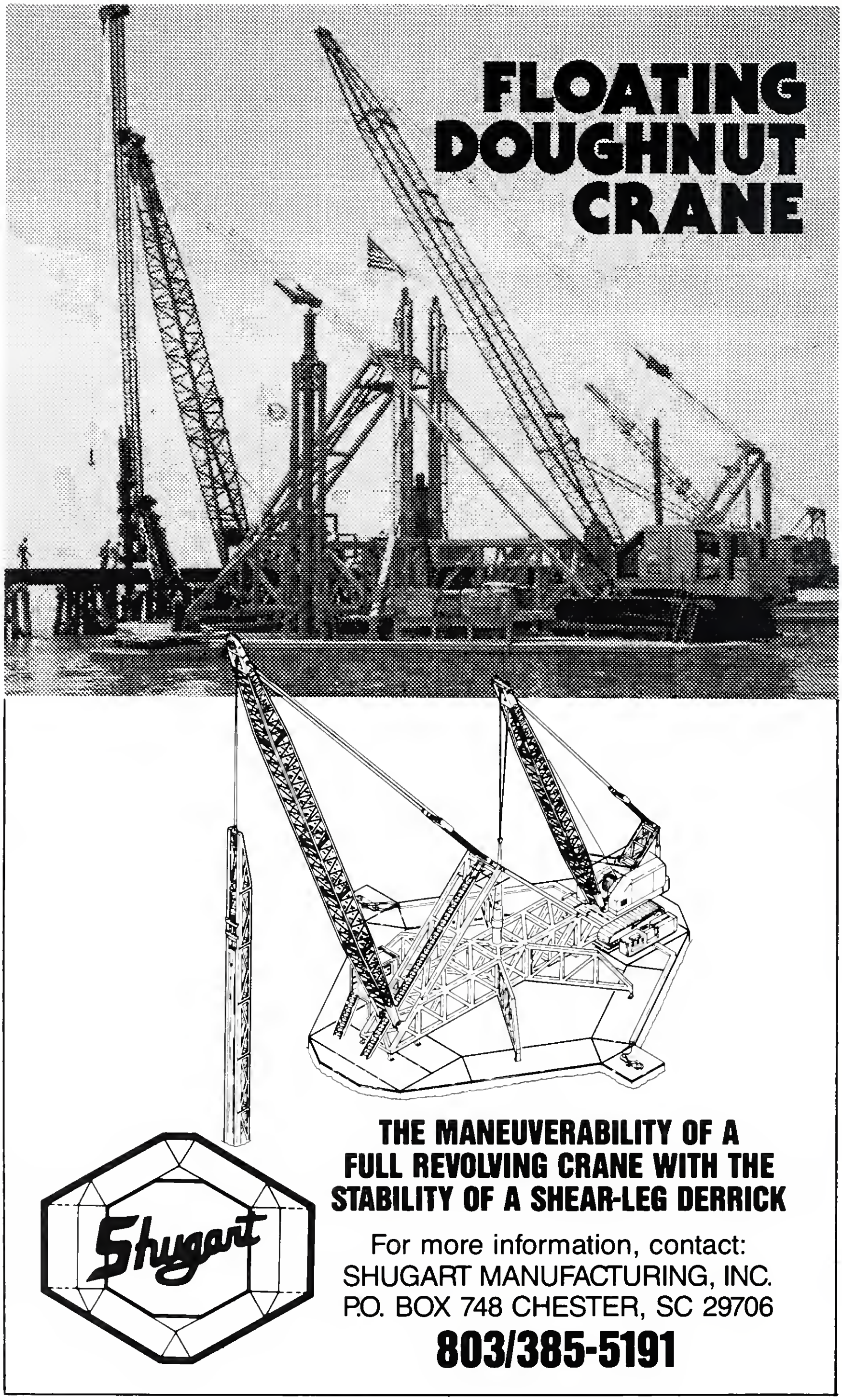

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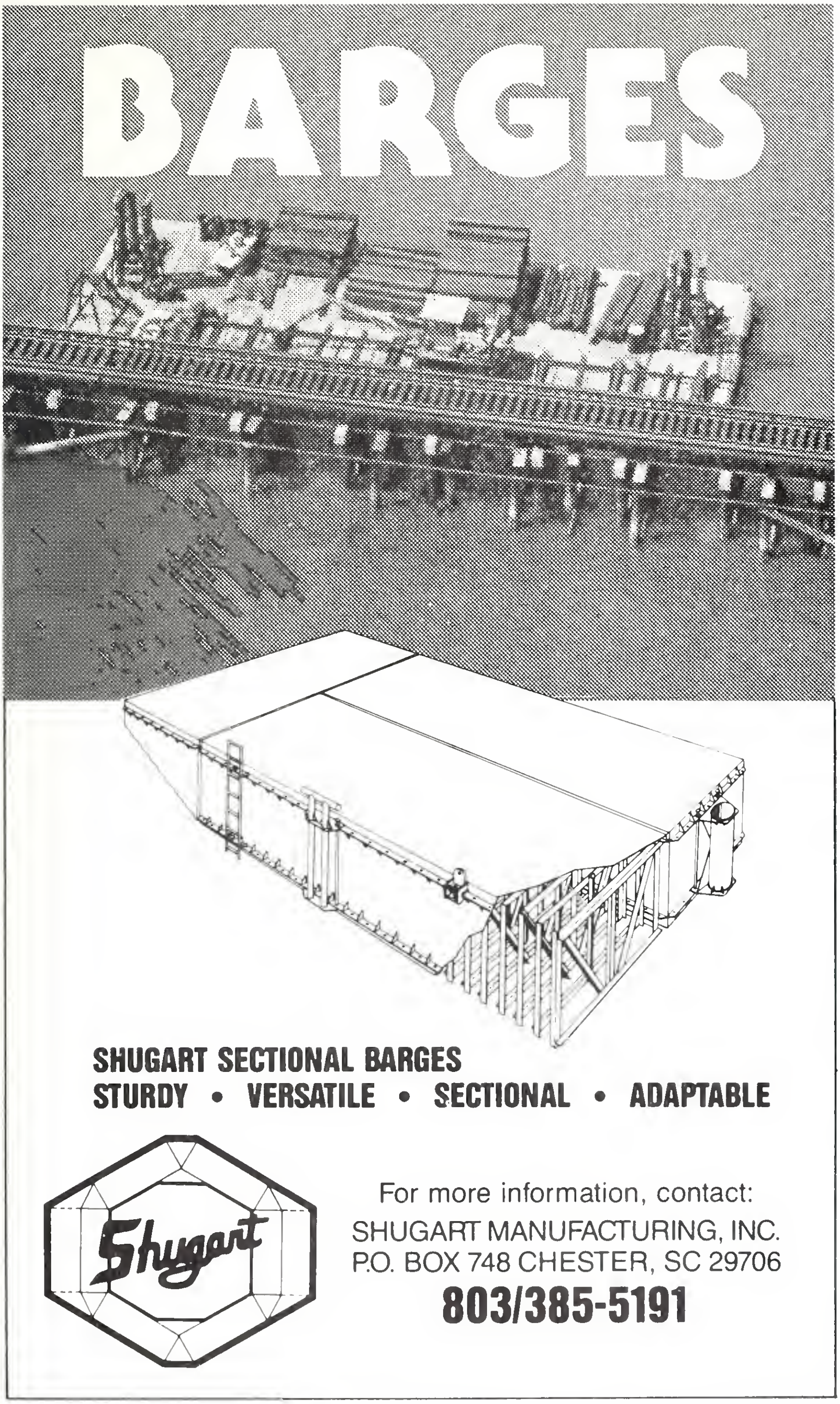

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